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Photo courtesy of Hamman, Jensen, and Wallen.

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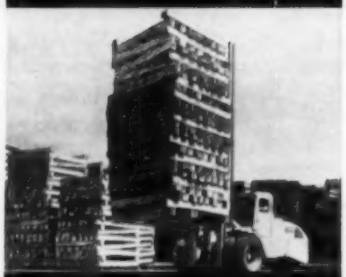

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Journal of Forestry

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Longleaf Pine Direct Seeding[1]

Harold J. Derr and Floyd M. Cossitt

Research forester, Southern Forest Experiment Station, and forester in charge of planting, Region 8, Forest Service, U. S. Department of Agriculture

In the years 1946-1952 at least 8 direct-seeding tests were made with longleaf pine on open cut-over land. The authors discuss the climatic and biotic factors that determine success or failure and give tentative recommendations for direct seeding of this species.

THE PRINCIPAL BLOCK of forest land requiring artificial regeneration in the South today is cut-over longleaf pine land. A succession of destructive events—clearcutting, repeated wildfires, and hog depredation—has left thousands of acres without adequate reproduction or a source of seed for natural regeneration. It is estimated that in Louisiana alone there are 1.5 million acres of such land.

Planting is in progress on these lands, but the job is so immense that it will take from 25 to 40 years to complete. Moreover, longleaf pine is difficult and expensive to plant. Planting costs, including seedling production, are currently averaging from $10 to $16 per acre.

Reforestation by direct seeding has long been recognized as a potentially quicker and cheaper method than planting, provided a reliable technique could be developed. Longleaf pine is well adapted to direct seeding. The seed is not difficult to collect in quantity when available—enough to sow an acre usually costs no more than $4.50 to $6.00. Viable seed germinates and sheds the seed coat rapidly, in 4 to 6 weeks if rainfall is adequate. Consequently, it is vulnerable to birds and rodents for only a short time, and intensive predator control is feasible.

A reliable technique for direct-seeding longleaf pine with assurance of good first-year stocking has not been developed. However, progress has been made in identifying many of the factors responsible for past failures. Between 1946 and 1952 at least eight direct seeding trials with longleaf pine were made in central Louisiana and south Mississippi. The trials varied in size from small experimental plots to sowings of 1,000 acres or more. In each case sufficient observations were made to determine the major cause of seed losses, and to record the degree of success or failure.

Seeding has been done on fresh burns; 1-year grass roughs; old, heavy grass roughs; and disked strips. Time of sowing has varied from early November to February. Airplanes have been used to distribute seed on the larger areas, although in one recent trial approximately 1,000 acres of disked strips were sown with tractor-mounted seeders. Hand-operated grain seeders were used on small experimental plots and in pilot-plant tests up to 100 acres in size. The seeding rate per acre has varied from 1.7 to over 5 pounds, but in general about 3 pounds per acre were used.

A total of 4,000 acres were seeded. On 1,500 acres better than 1,000 seedlings per acre were established at the end of the first growing season (Fig. 1), 370 acres were partially successful and 2,050 acres failed. However, these figures are not a true yardstick of the effectiveness of direct seeding because some procedures used in early investigations are now known to be wrong.

The following discussion brings

FIG. 1.—Longleaf seedlings 5 years after seeding on disked experimental plots.
Photo by Louisiana Forestry Commission

[1]The authors are indebted to J. T. Koen, ranger, Chickasawhay District, De-Soto National Forest; to H. S. Redding, supervisor, Kisatchie National Forest; and to C. H. Lewis, Jr., forester, Crosby Chemicals, Inc., De Ridder, La., for providing data on their direct-seeding trials.

FIG. 2.—Longleaf seedlings 28 days after sowing on disked strips in early November. With early sowing and favorable weather the germination period averages 4 to 6 weeks. These seedlings are practically beyond danger from birds.

Photo by Louisiana Forestry Commission

out many of the factors involved in direct seeding of longleaf pine, the pitfalls to be avoided, and the best recommendations now known. Since this work is still in the experimental stage, all recommendations are tentative.

Time of Sowing

The most important factor in direct-seeding longleaf pine is to sow when soil moisture is adequate for prompt germination, but before migratory birds reach their peak. In central Louisiana and Mississippi these conditions are usually met in late October or during November. At least 1½ to 2 inches of rain should have fallen just prior to sowing. But once the fall drought is broken, it is important to sow immediately (Fig. 2). Undue delay will extend germination into late December when migratory birds are numerous. In four trials, heavy seed losses from birds were sustained because seeding was delayed by late rains or difficulties in seed procurement. Until reliable bird control measures are developed, it is recommended that if the fall rains do not start until December, it is best to delay the work until the following year.

Seeding before November or before adequate rainfall is also hazardous because hot dry weather may destroy the seed. One trial in 1950 failed because 14 days of unseasonably hot weather followed seeding on November 4.

Seed Quality

At least 10,000 viable seed should be sown per acre. Even under favorable conditions, only 10 to 30 percent of the seed can be expected to produce seedlings for initial stocking. This means that with good seed, testing about 70 percent germination at least three pounds of dewinged seed per acre are required.

In at least two trials, failure or low stocking was largely due to poor seed. Quality of the seed to be used should be accurately determined for each lot prior to sowing by complete laboratory germination tests under controlled conditions. These are necessary for computing the amount of seed to be sown per unit of area.

In most trials to date an effort has been made to use fresh seed entirely. This is unnecessary, provided viable stored seed[2] is available. In fact, the use of stored seed provides greater opportunity to coordinate seeding date with favorable weather conditions. The optimum period for seeding often comes too soon after cone collection to permit the use of fresh seed to good advantage.

Site Preparation

A one-year grass rough, following a late winter or early spring burn, provides a satisfactory seedbed. Such a light rough permits seed to reach mineral soil for prompt germination, yet gives some protection from birds and rodents.

Disking a light rough during the summer before sowing has been used in two trials with good results. Disking may not improve initial germination, but it reduces the grass competition enough to insure better first-year survival if the summer is dry. For example, in the extremely dry summer of 1948 practically all seedlings were lost on a fresh burn and on a 1-year-old rough, while in the same study a good stand came through on disked plots. On dry, sandy sites disking is recommended to reduce drought losses. On better sites, it appears to be a matter of choice. Disking costs can be reduced to $2 to $3 per acre if 8-foot strips spaced 6 to 8 feet apart are used. While somewhat faster initial growth has been observed on disked ground, there are also disadvantages. Some seed and seedlings are lost to silting, brown spot needle infection is greater when mineral soil is exposed, and disked strips may be grazed excessively where grazing animals cannot be controlled.

Fresh burns are not recommended, although longleaf seed germinates well on this type of seedbed. In at least 3 trials, burning just before sowing attracted many species of birds. This has been especially true with late sowing. It is also advisable to avoid burning on adjacent areas, if possible.

Grass roughs older than one year are not suitable seedbeds for longleaf pine. Heavy roughs obstruct germination, and usually harbor a high rodent population.

Methods of Sowing

Seed has been distributed by airplane, by hand-operated grain seeders, and by specially constructed seeders mounted on a tractor. All methods are fairly reasonable in cost and each has certain advantages. Aerial seeding is fast and is probably the best method on large areas if the equipment is capable of distributing longleaf seed accurately. Of course, aerial seeding cannot be done on disked strips. The chief disadvantages are that it is difficult to obtain uniform distribution of seed, and often the best weather for germination is poor flying weather.

On areas up to 300 acres in size, sowing with hand-operated grain seeders seems to be the most economical and satisfactory technique. One man on foot can sow 30 acres in an 8-hour work day, and the seeders can be accurately adjusted to distribute the desired amount of seed. Areas not requiring seeding can be readily by-passed.

On disked strips it is necessary

[2] Wakeley, P. C. Storing southern pine seed. South. Forest Expt. Sta. Occas. Paper 123. 13 pp. 1951.

to broadcast the seed by hand or to use a tractor-mounted seeder. With a tractor seeder, one man can sow about a 40-acre tract in an 8-hour day.

The method of seeding selected for a particular area should be fast enough to complete the job while the weather is the most favorable for rapid germination.

Predators

Birds. — Birds constitute the greatest single obstacle to successful direct seeding. Longleaf pine seed is a choice item in the diet of many species of resident and wintering migratory birds. In all large-scale tests of direct seeding some loss of seed to birds has been recorded and in several tests birds were primarily responsible for failures. Species and numbers of birds have varied not only from year to year but even in the same year on study areas less than 20 miles apart.

The meadowlark has proven to be the most troublesome resident bird. Observations in recent tests confirm much of the data presented by Burleigh.[3] He found that insectivorous birds, the meadowlarks in particular, will take longleaf seed as a substitute food during the fall months when natural seedfall or direct seeding is in progress. Frequent field observations and stomach examinations of meadowlarks taken from seeded areas have shown that seed losses to larks are usually very light during the first 10 days of the germination period. Losses increase rapidly when germination begins and the seed can be more readily separated from its wing stub. Lark damage continues throughout the germination period until the last seed coat has dropped off.

Losses to meadowlarks can be minimized by early seeding. With favorable weather, early seeding gets the seed through the critical germination period while other food is still available. In three trials, federal and state permits were obtained to control the meadowlark population with a shotgun patrol. While not yet proven to be a practical measure, patrolling did reduce the population for a limited time and undoubtedly saved considerable seed.

Other resident birds have not been a problem in any direct seeding test during the fall months. The population of quail has not been great enough to cause serious losses on large areas. Doves have not been observed on seeded areas during November and December, although they trouble pine nurseries during the late winter and early spring.

Among migratory species, blackbirds, juncos, and vesper and savannah sparrows have caused the heaviest losses. Damage from these birds could probably have been reduced by earlier seeding. Large flocks have not arrived until about the middle of December, although some sparrows begin to reach Louisiana in October.

Blackbirds have been the most numerous migratory species encountered. The experience of others with blackbirds indicates that there are no practical direct control measures. However, blackbirds do prefer recently burned areas, so the chance of loss can be minimized by seeding early on a light grass cover.

Juncos, and vesper and savannah sparrows, like blackbirds, feed in large flocks and can clean off an area in a short time. In 1952 these species were observed in large numbers on three separate test areas after December 15. They congregated wherever food was available, irrespective of ground cover. Early seeding appears to afford the best protection against these birds also.

Rodents.—Although rodents are potential obstacles to direct seeding of many conifers, recent observations and cooperative studies by the U. S. Fish and Wildlife Service confirm Burleigh's Mississippi findings[4] that rodents are not a problem with longleaf. The only rodent damage noted has been on old roughs. Rabbits eat seed regardless of rough, but seem unlikely to cause excessive loss.

Other animals. — Range hogs must be excluded from seeded areas because they will destroy seed as well as established seedlings. They are particularly devastating on disked strips. Other large animals that are known to take seed include raccoons and opossums. A presowing check should be made to determine if these or other animals are numerous enough to require control.

Ants. — Texas leaf-cutting or "town" ants (*Atta texana*) destroy germinating seedlings within the feeding range of their colonies. They are found only in limited areas of central and western Louisiana and east Texas. They can be controlled with methyl bromide and should be eliminated prior to seeding.

Species of smaller ants have been observed eating seed and the foliage of newly germinated seedlings in all direct seeding trials. At times the extent of their activity appeared alarming, but detailed observations in 1952 showed that combined seed and seedling losses to ants (other than *Atta*) do not exceed 10 percent. Ant damage may be greater in other years or on different areas, but at this time it does not appear that control measures for ants, other than town ants, are required unless they become a limiting factor on specific areas.

Recommendations

Additional research is required, particularly in the field of bird control, before a completely reliable technique of direct seeding longleaf pine can be formulated. However, the results of at least 8 trials, totaling nearly 4,000 acres, at several locations in Louisiana and Mississippi are available as a basis for the following tentative recommendations.

1. Seeding should be done as early as weather permits, but not before late October or early Novem-

[3] Burleigh, T. D. The relation of birds to the establishment of longleaf pine seedlings in southern Mississippi. South. Forest Expt. Sta. Occas. Paper 75. 5 pp. 1938.

[4] Op. cit.

ber. In some years soil moisture may not be adequate for germination until late November or December. Seeding after December 1 has met with poor success, and it is probably better to defer the job a year than risk seeding that late.

2. The best seedbeds are light roughs or disked strips on a light rough. The seedbed should be prepared by burning the old rough 5 or 6 months before seeding. Fresh burns attract birds and should be avoided even on areas adjacent to the seeding. Disking is recommended on all poor, dry sites; and even on good sites it provides insurance against heavy losses in a drought year. It should be done about 3 months before seeding, so that rains will settle the soil.

3. Seed should be obtained at least a year in advance and properly stored. Although fresh seed is preferable in some respects, it cannot always be obtained in quantity when conditions are favorable for seeding.

4. Seed should be adequately tested to insure a seeding rate of at least 10,000 viable seed per acre.

5. In addition to seedbed preparation, preliminary work should include hog exclusion, town ant control, and a reconnaissance to determine the species and number of seed-eating birds or animals on the area. Control measures, within the limits of the game laws, are advisable if the population is high. Birds such as meadowlarks can be controlled by shooting only with the permission of state and federal game authorities.

6. Frequent and detailed observation of germinating seed should be made to reveal the class of seed predators at work. After germination is completed a reliable sampling method should be used to estimate initial stocking. Often a seeded area appears to be a failure until a careful seeding count is made.

7. In areas where direct seeding has never been successfully attempted, small-scale sowing, about 100 acres in size, should be the rule for initial trials.

8. Grazing animals will destroy established seedlings by trampling or browsing and should be excluded until height growth has started.

George H. Cecil (1877-1954)

George H. Cecil of Burbank, Calif., died last fall at the age of 77. Through inadvertence, the JOURNAL OF FORESTRY was not previously notified of his death, and the editors regret the delay in the publication of this obituary.

Mr. Cecil was born September 6, 1877, in Baltimore, Md. He entered the Biltmore Forest School in 1902, was graduated a year later, and immediately entered the Bureau of Forestry, U. S. Department of Agriculture. In 1905, he was assigned as forest supervisor to the Yellowstone Forest Reserve and, when national forests districts were established in 1907, he was assigned as inspector working out of the district office at Missoula, Mont., later transferring to the Washington, D. C. office in the Division of Operation.

In 1908, he was transferred to Portland, Ore., as associate district forester and, in 1911, became district forester of what was then the North Pacific District. For fourteen years Mr. Cecil managed the twenty-six national forests of Washington and Oregon that comprised Region 6 of the Forest Service.

In 1924, when California had one of the worst forest fire seasons in its history, Mr. Cecil was assigned as supervisor of the Angeles National Forest where for four years he successfully improved the fire prevention and control program.

The Los Angeles Chamber of Commerce in 1929 offered him a position as manager of its Conservation Department and executive secretary of the Conservation Association of Southern California. Mr. Cecil served in this capacity until his retirement September 30, 1949.

Mr. Cecil's influence on forestry in the West, and especially in southern California, will be felt for many years.

An Analysis of Forest Production Goal Methodology[1]

G. Robinson Gregory
George Willis Pack,
assistant professor of resource economics, University of Michigan, Ann Arbor

THE ALMOST universal approval granted the work of the Forest Survey has been attained by few other Forest Service activities. Both professional and nonprofessional groups have recognized the desirability of determining the extent and condition of the nation's forest resource and have welcomed the various factual presentations containing survey data.

In addition to these reports of limited geographic applicability, the Forest Service, since 1930, has made three summary presentations —the Copeland Report (*3*), the Report to the Joint Committee on Forestry (*4*), and the series of Reappraisal Reports (*6, 7*). In all three, data from the various survey units have been aggregated, and after interpretation have been taken by the Forest Service as guides to broad policy formulation at regional and national levels. The interpretations of these national summaries, and to an even greater extent, certain of the derived policies, have been accorded a somewhat less enthusiastic reception than have the original data upon which they depend.

A basic feature of these reports has been the derivation of quantitative goals for American forest production. These goals, termed "growth goals" in the reappraisal studies, have been the cornerstone for much of Forest Service policy. Many foresters would no doubt argue that such long range goals are valueless—that they assume a knowledge of the future that is "ridiculously presumptuous."[2] But such arguments miss the fundamental point. Timber production is, by its very nature, a long term undertaking, and any advocate of "sustained yield" or "continuous production" of forest land must assume satisfactory markets for the forthcoming timber products. For a national agency such as the Forest Service to attempt policy formulation for timber production without long range production goals would be folly indeed.

Yet this does not mean that present production goals are suitable for such use. The analytical framework used in establishing Forest Service growth goals has remained essentially unchanged since the appearance of the Copeland Report. Today, with a new "Timber Resource Review," it seems desirable to subject this framework to a critical examination.

One important distinction should be made at the outset: this article will deal with the methodology used in deriving forest production goals —not with the goals themselves. An example may demonstrate why this point is believed important. It is entirely possible that valid quantitative production goals might be established by drawing numbers from a hat. Were such a procedure followed, however, the methodology (and indirectly, the goals so established) would almost certainly be challenged. Similarly, though attention will here be confined to methodology, the goals themselves may indirectly be challenged. Guides to national policy should rest on careful, logical reasoning, and any goal established through illogical or faulty methodology is open to serious question. Yet it should be remembered that even though the methodology may be found faulty, these same goals might eventually prove to be sound. Such proof, however, would necessarily lie in a comparison of existing goals with new ones derived through different procedures; yet unless these new procedures had been developed and quantified, any comparison would be impossible. It would appear more sensible to be sure that the methodology is sound.

One further step remains before beginning the review itself: if this analysis is to proceed objectively there must be clearcut criteria for evaluating the soundness of the methodology. It is not suggested that the following criteria be the sole test of acceptability. It is submitted, however, that failure to satisfy these conditions renders the methodology unacceptable. The proposed criteria are:

1. The methodology must be consistent with the economic and social framework within which the goals are to apply.

2. Since these are to be goals for forest production, the techniques and peculiarities of the forest production process itself must be specifically recognized.

These are necessary though not sufficient conditions that must be met by any acceptable methodology. If the criteria are not met, the Forest Service growth goals are, and have been, based upon unsound premises and should not be accepted as logical guides to policy formulation. Moreover, it would follow that major elements of Forest Service policy rest on shaky foundations.

The remainder of this article is divided into two parts. The first presents a review of how Forest Service growth goals have been derived; the second will demonstrate that neither of the above criteria is satisfied by Forest Service methodology.

Growth Goals

Forest production goals were first termed "growth goals" in the Reappraisal Report, where the term was defined as being the quantity of forest growth which would provide "as much timber as a pros-

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[1]The basic analysis for this article was completed while the author was a graduate student at the University of California.

[2]For an expression of the view that long range production goals are valueless, see "Forest Planning: How Far Can We See?" Ellery Foster, Jour. Forestry 35: 1066. 1937. This stand was admirably countered by Henry Vaux in "Some Economic Goals in Forest Policy", Jour. Forestry 47: 612-617. 1949.

perous people might use if the supply were sufficient to keep forest products available at reasonable prices" (*6*). Similar goals (although not so named) were developed in both the Copeland Report and the Report to the Joint Committee. In all three studies the methods followed in constructing the production goal were nearly identical: to a quantity usually called "requirements" or "potential requirements" was added (1) an allowance for accidental loss from fire, insects, and disease, and (2) a "safety-margin" to cover new uses, possible exports, and to provide for national security. Obviously, the requirements quantity is the basic constituent of Forest Service growth goals, and as such merits careful examination.

The Requirements Concept

"Requirements" was first described in the Copeland Report (*3*) by Hallauer, who wrote:

" 'Requirements' is not a wholly satisfactory term to define the extent of past, present, or future use of wood. Where timber is abundant and easily accessible, 'requirements' inevitably absorb a far greater quantity of this cheap and adaptable raw material than would come into demand under other circumstances; . . . On the other hand, where wood is scarce and hard to get, actual use is not a measure of what requirements might be under favorable conditions. The community or region may not consciously demand more wood and may yet be at a disadvantage in a number of ways through lack of an abundant supply of wood at hand."

In both the Report of the Joint Committee and in a subsequent article by Marsh and Gibbons (*5*), the term "future drain" was substituted for "requirements". There seems nothing to suggest that this change was other than one in terminology.

A minor alteration was made by the authors of the Reappraisal Reports, who defined "potential timber requirements" as: "the quantity of timber products that might be used by consumers afforded reasonable latitude in choice of readily available materials, including timber products, in a national economy functioning at a high level of employment and output" (*7*). The concept was also discussed at some length in an article by Rettie (*2*).

A "Model" of Requirements

To see more clearly what is involved in this requirements concept it is helpful to employ a well-established tool of the economist—the economic model. These simplified systems, by ignoring all but the critical factors, serve to demonstrate how chosen variables interact to produce effects significant to the problems under consideration.

From assumptions either stated or implied in the Reappraisal Report (taking this as the most recent example) an economic model of the requirements concept may readily be constructed. Two of the basic assumptions specify the general economic conditions anticipated for the year 2020—the year for which the growth goal was determined. They are stated in Report No. 1 as:

1. An economy characterized by full employment (about five percent unemployed).

2. A population of about 167 million (population was assumed to increase until 1990, then level off).

Since the federal government has assumed responsibility for maintaining employment at a high level, the first assumption is certainly reasonable from the standpoint of a federal agency. And, while the second assumption might now be criticized as being much too low, the population forecast was based on what was then considered a reasonable estimate. The decided upward shift in population expectations is one of the better reasons for undertaking a new resource review.

Since no change in the method by which consumers presently allocate their income is anticipated, a third (implicit) assumption might be listed as:

3. Consumers may spend their income as they see fit, adjusting quantities purchased according to the prices of the various commodities.

By this assumption "reasonable latitude in choice" is assured consumers. But this, in turn, requires some assumption concerning price relationships.

Though none is clearly stated in the Reappraisal Report, it appears that "reasonable latitude in choice of available materials" was interpreted in an historical sense, and that the period between the two World Wars was taken as a base. A fourth assumption can therefore be implied:

4. Price of timber products is to bear the same relationship to competing materials and to the general price level as in the period 1920-1940.

From the four preceding assumptions, the Forest Service requirements problem can be restated rather specifically in question form: Under full employment in the year 2020, with people free to spend their income as they choose, what quantity of timber products will be demanded by a market of 167 million consumers?

This problem is illustrated in Figure 1. *DD* is a conventional market demand curve representing a schedule of the quantities of the timber products consumers would be willing to purchase at various prices: as price falls, more and more timber products will be taken. The market period is the year 2020, and prices of all other commodities are considered as constant throughout this period. At the price *P*, chosen so that P represents that price of timber products which bears the same relationship to competing products and to the general price level as in the period 1920-1940, the quantity *Q* will be demanded. This *Q*, then, represents the "potential timber requirements" for the year 2020. Conversion to stumpage equivalents might be accomplished in any of several ways.

Requirements, it appears, deals only with demand at a predeter-

mined price. This is perfectly in order so far as the concept itself is concerned, but we must now see whether this concept is, or can be made, suitable for use as the major component of national forest production goals.

The First Criterion Test

The first criterion by which the methodology is to be judged concerns the economic and social framework within which the goals are to apply. Basic to this nation's structure are two related institutions—private ownership of property, and production for profit. Forest production goals for this nation can hardly ignore the fact that some three-fourths of our commercial forest land is in private ownership, and that on much of this land, management will be concerned primarily with producing timber products for profit. Growth goals should deal at least partly with the producer's side of the picture.

Requirements, as we have seen, deals only with the demand concept. Yet there is one possibility of bringing the producer's reaction into the framework, for closely analogous to the consumer's quantity-price relationship that is called demand is the equally important *producer's* quantity-price relationship called *supply*. The supply curve shows the amount that producers would be willing to supply at each of the various prive levels. The two concepts come together in the market place—supply and demand are equated at some particular price. In fact, we can say that price is determined by the intersection of these two curves.

This is certainly no innovation. There is probably no one economic principle so frequently quoted as the market law—the relationship between supply, demand, and price. But a very particular price was chosen to determine requirements,[3] and the requirements quantity then converted to the growth goal. It must therefore be concluded that the two curves, supply and demand, were assumed to intersect at exactly the chosen price level.

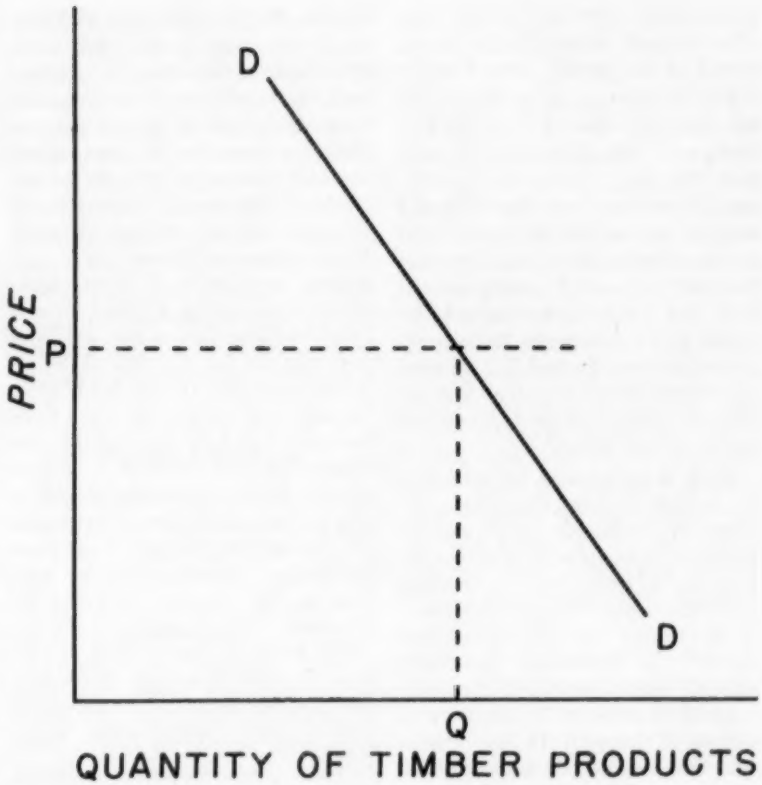

Fig. 1.—A "Model" of the Forest Service requirements concept.

No thorough-going analyses of timber product demand have ever been made. In fact, so little is really known about timber products demand that it could conceivably be represented by any one of an infinite number of possible curves. Yet the growth goals determined by the Forest Service analysis depend on a particular price: price is given by the fourth assumption of the requirements model. The only logical conclusion would seem to be that the demand curve for timber products, *regardless of where it happened to lie*, would interest the supply curve at the chosen price level. This could, of course, result from chance, but if this were the only basis for the chosen price the production goals might just as well have been drawn from a hat. There are, however, two situations in which reliance would not have to be placed on chance. Either one of two assumptions regarding the supply curve would still give the Forest Service growth goals a logically sound basis, though the methodology would not necessarily be consistent with reality. First, it might be assumed that timber supply can vary considerably without any price change—that at least a portion of the supply curve could be represented by a horizontal line at the chosen price.[4] Alternatively, the supply curve might have been assumed to be at least somewhat sloping, but shifting under some influence so that the point of its

[3] Given the general price level and the prices of competing products for the year 2020, whatever these prices might be, only one timber products price will exist which will "bear the same relationship to competing products and to the general price level as in the period 1920-1940". Although the selected price is a *relative* price, it is still a very *particular* price.

[4] In economic terms, the first situation assumes that within some range of output the supply curve is perfectly elastic. In the second situation the supply curve is assumed to be imperfectly elastic.

intersection with any of the possible demand curves would always result in the chosen price level.

The first situation is illustrated by Figure 2. Here. DD, D_1D_1, and D_2D_2 are possible demand curves, and SS, S_1S_1, S_2S_2, are possible supply curves. Provided that the supply curves are horizontal and at the chosen price level between the points X_1 and X_2, and provided that the yet-to-be-determined demand curve intersects the supply curve between X_1 and X_2, we need not worry about supply. The required supply will be forthcoming at the chosen price.[5]

Such a model may be criticized on at least two specific points: the shape of the supply curve, and its position. A supply curve shows the response of producers to shifting price levels only because this curve is in reality an aggregate cost curve.[6] A horizontal (perfectly elastic) supply curve implies that costs of production do not vary as output is changed. In the present case this means it is assumed that large quantities of stumpage can be produced just as cheaply (in fact, at exactly the same cost) as small quantities.

This would hardly seem to be consistent with what little we know about stumpage production costs. If we assume that the area of forest land, nationally, is to be constant, then output can be varied only by changing intensity of management —which is exactly the way the authors of Reappraisal Report No. 1 intended output to be changed. Under these conditions we should expect, eventually at least, additional input units to yield successively smaller increments of product—the old familiar law of diminishing returns. If this holds true, in order for the supply curve to be horizontal at least some of the productive factors will have to be purchased under conditions of declining prices. And further, the rate of decline in the prices of these productive factors must be such that it will exactly offset the decreasing yield of product. On the other hand, if factor costs are assumed either constant or increasing, a rising supply function would follow (the supply curve would slope upward and toward the right).

No studies have been made along these lines, but any assumption involving a horizontal supply curve is, to say the least, highly questionable.

A more obvious criticism of this model for production goal derivation concerns the level at which production costs are placed (the level of the supply curve). As Vaux and Zivnuska express it: (9)

> During the base period used in the timber requirements analyses the supply of timber consisted almost entirely of virgin or voluntary stands, thus making it highly unlikely that the quantity of standing timber reflected any high degree of adjustment to the equilibrium requirements of equality between rate of production and rate of consumption. From this it follows that equality between costs of production and selling price of timber is improbable, and so there would appear to be no reason for setting future costs of production at this level.

An assumption of a horizontal supply curve might have been valid during a period when the supply of timber consisted of virgin or voluntary stands, though varying accessibility makes even this highly unlikely. The fact that virgin stands were relatively plentiful, both when the first requirements studies were made and during much of the base period used by the Reappraisal project. lends credence to the supposition that Forest Service investigations may have been predicted upon a horizontal supply curve.

According to the opening paragraph of the second report, however, ". . . that era is closed. The time has come when timber growing, in contrast to timber exploitation, must be undertaken on a nation-wide scale." An assumption of a horizontal supply curve would seemingly indicate a serious lack of recognition of either the truth or the significance of this opening paragraph.

Now, what about the second situation, in which the supply curve is assumed to shift so that its intersection with any possible demand curve would result in the predetermined price. Such a situation would necessarily presume

[5] A somewhat similar treatment of Forest Service growth goal work has been presented by Vaux and Zivnuska in "Forest Production Goals: A Critical Analysis" (9).

[6] Under purely competitive conditions, any point on a market supply curve represents an aggregation of individual producer's marginal costs curves—that is, at any given price level the supply curve represents the summation of the outputs of all producers, each of whom is producing that output which will maximize his profit at the given price. Since profit for each producer will be maximized when his marginal cost of production equals product price, the market supply curve can be thought of as being the result of a "horizontal addition" of all the producers' marginal cost curves.

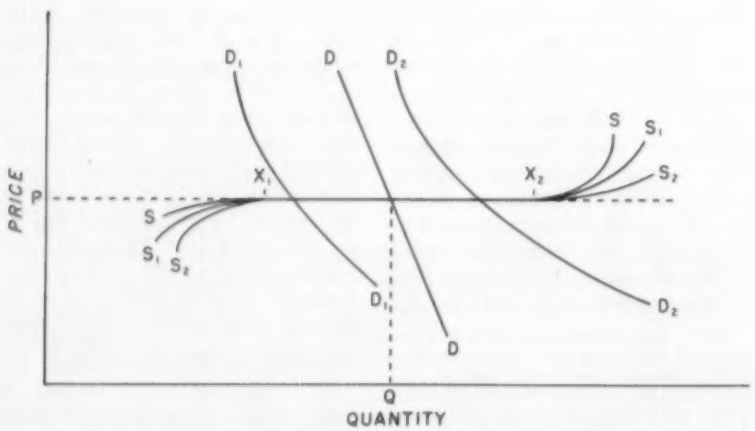

FIG. 2.—One possibility of applying the requirements concept to growth goal formulation. Irrespective of its shape, as long as the demand curve intersects the supply curve between X_1 and X_2, the desired quantity will be forthcoming at the price, P.

that the planning agent setting the growth goal is able, and intends, to manipulate the costs of production—either by direct regulation, or by subsidy or taxation or other indirect means—in such a way that price could be fixed at any chosen level. This assumption is so inconsistent with reality that it merits no further development.

Only under these two situations, however, could the growth goal methodology presented in the national summary reports be considered logically valid. Yet neither of these situations is consistent with the economic or social framework within which the goal is to be achieved. The remaining possibility is to assume that the authors of the reports simply ignored, or overlooked, the supply factors. In this latter (and more likely) case, the growth goals set by the past Forest Service workers stem from an invalid analysis.

The Second Criterion Test

The second criterion states that the methodology should specifically recognize the techniques and peculiarities of the stumpage production process. After the foregoing development it seems quite obvious that this criterion is not met, for only through a careful development of the *supply* side could the production process possibly be considered. Yet supply was given no treatment—the requirements model is concerned only with demand at a pre-determined price.

If any further proof were desired, one need only point out that in stumpage production any harvest has a decided effect upon those cuts which follow. The Forest Service growth goal of 72 billion board feet of saw timber is a target to be reached at a particular point of time, arbitrarily set as the year 2020. There is no explanation of why this date was chosen, nor any indication that other dates were even considered. Yet it seems hardly reasonable to expect the operators of private timber lands to ignore the costs and returns of all operations between the present and the year 2020.

From this it would seem possible to draw one general conclusion about forest production goals themselves: Forest growth (production) goals must be planned patterns of stumpage output over time, instead of output targets for arbitrarily chosen dates. Any goal that fails to present a *pattern* of output over time will be of little use to forest managers, and any methodology for deriving such a pattern will certainly need to be based on the stumpage producing process itself.

Further Objections

Irrespective of the underlying assumptions regarding supply there are other objections to use of the Reappraisal methodology in formulating growth goals as guides to forest production.

It seems, for example, that an analysis made by a national agency should properly attach considerable weight to possible emergency requirements — military demands and the like. This margin of safety, however, does not require an *annual production* of the added amount, but instead necessitates a reserve—a surplus—from which these emergency demands could be met when needed. Actually, forest harvesting and marketing (as contrasted with forest production) has a high degree of flexibility—enough to take care of a considerable variation in annual amounts cut. If this inherent flexibility is not deemed an adequate safety factor the required reserve might well be maintained in the National Forests. As a matter of fact, while no such recommendation is intended here, such a move should not prove particularly difficult for an agency controlling $^1/_5$ of the nation's commercial forest land. At any rate, the effect on market price of an annual production over and above that calculated as sufficient to fulfill market demand should be carefully considered. Such consideration, of course, would entail the determination of more than a single point on a demand schedule.

A distinctive aspect of the Reappraisal analysis is found in the program designed to meet the growth goal. The reader will recall that suggested management programs have called for a reduction in output in order that the growth goal might be met. According to the 1946 study, for example, sawtimber cut would be restricted to approximately 50 billion board feet for a 40-year period so that the goal of 72 billion board feet could be achieved in the year 2020. Such a program requires restricting present output so that future wants might be met,[7] implying that a negative social time preference rate (the rate at which society discounts future goods when compared with present goods) should be used in forestry calculations. And not only is the rate negative—it is also a changing rate.

The social time preference rate appropriate for use in conservation studies has long been a matter of dispute. Proposed rates have ranged from the market rate of interest down to zero, but so far as the present author can remember, negative rates have been suggested only if wants (or "needs") were expected to increase over time. The studies reviewed here have not demonstrated any change in the intensity of wants or needs of individuals—in all cases the need is the same. The logical basis for a changing rate is nowhere to be found in the Forest Service studies.[8] And why we should plan to restrict lumber use for the next 40 years in order that citizens yet unborn will not be required to restrict their use to a like degree is a question the study fails to answer, or even consider.

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[7] Vaux and Zivnuska (*9*) observe that a program of restricted output might also tend to shift the demand curve to the left —that if output is curtailed present markets might be permanently lost to substitute materials through consumer taste changes.

[8] Conceivably, an increasing population might raise the "needs" of society even though individual needs remained unchanged. On this basis one might argue that a negative social time preference rate is appropriate to a nation with an expanding population.

Summary

In summary, it seems clear that the methodology used in past Forest Service growth goal studies fails to pass critical review. Little consideration was given the technical relationships involved in calculating the goal other than to demonstrate that attainment might be a physical possibility. Supply was given practically no consideration —certainly nothing beyond lip service was paid to the fact that our forest situation has changed from one characterized by virgin timber to one typified by timber that is commercially produced. The growth goal as such was specified as a target while the interelationships involved necessitate a *pattern* of planned output through time.

While the conclusions drawn from these studies cannot be challenged at this time (for there is nothing with which they can be compared) it seems clear that if they are correct it must be the result of fortuitous circumstances.

If this nation's forest policy is to be directed toward the achievement of forest growth goals, the methodology of deriving these goals should be altered. The interrelationships between production factors and between the outputs of different time periods, must be given due consideration. Supply factors, as well as demand factors, must be brought into the picture. Instead of targets at some point in time, growth goals must become *patterns of output through time* which are consistent with the technical facts of life, and with the economic and social framework within which the goals are to be achieved. On all these counts present Forest Service methodology is found wanting.

Conclusion

Growth goals are a prerequisite to forming the nation's forest production policy. Present methodology does not lead to goals which can be taken as logical guides to such policy formulation. New procedures are needed: some methodology must be found through which these goals might be derived.

A forthcoming article will further discuss the kind of growth goal which would provide a satisfactory basis for policy, and will suggest a methodology through which these goals might be established.

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Viviparity in White Oak

The 1954 acorn crop of *Quercus alba* in the New Jersey area was particularly heavy. Viviparity was observed on a tree, growing at the edge of a woodlot on a College of Agriculture farm in New Brunswick. The soil is a shallow Sassafras sandy loam underlain by Triassic red shale with a slope of 10 percent. An intensively cultivated and fertilized peach orchard is contiguous to the upslope side of the wood lot.

By September 20 about one percent of the acorns had germinated upon the tree and had radicals projecting about ½ inch. Within two days of gathering, 10 percent of two pounds of collected acorns had germinated in a dry open box. Additional germination tests revealed an average germinative energy of 76 percent in six days and a total germinative capacity of 84 percent.

Acorns of several species of white oaks commonly start germination shortly after they fall; perhaps this case of viviparity can be partially explained by the rainfall of 9.12 inches in the 32 days preceding collection.

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Predicting Future Stand Volumes for Young Well-Stocked Douglas-fir Forests: A Comparison of Methods

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ANYONE faced with the problem of using normal yield tables to estimate future timber volumes for a young stand of Douglas-fir has a choice among several methods. All of these methods involve some assumed relationship between actual and normal stands. Some are simple and easy to apply, while others are complicated and require considerable effort. The question naturally arises—"Which of the available methods is most accurate?"

A Test

In an attempt to provide at least a tentative answer to this question, seven estimating techniques were compared using data from 17 permanent growth plots.[2] Present volume for each plot was estimated by the seven methods using stand data available when the plot was established. Differences between estimated and actual volumes were then analyzed to determine the relative accuracy of each method.

A method was considered biased whenever the average of its 17 differences was greater than twice the standard error of the average difference. Among unbiased methods, the one showing the least variation among individual differences was called most accurate. Variance was used as the index of variation.

The stands under study ranged in age from 38 to 103 years; in site index from 122 to 190; and in stocking[3] from 35 to 338 percent of normal. This range in stocking is deceiving since there were 16 cases of high stocking and only one of low stocking. Results of the test, therefore, apply mainly to well-stocked stands.

Geographically, the plots represent a large part of the Douglas-fir region. They are scattered from the Pacific Coast to the foothills of the Cascades, and from the headwaters of the Willamette River in Oregon to the Puget Sound area in Washington. The length of time during which measurements were taken on the plots varied from 5 to 41 years.

Methods Tested

Conventional by volume.—One of the conventional[4] methods for predicting future stand volumes has been to express present average volume per acre as a percent of corresponding normal yield table volume. This percent is then multiplied by the yield table volume at some future age to obtain an estimate of future volume.

Conventional by basal area.—Under this method the percentage factor applied to future normal yield table volumes is based on the relationship between present average basal area per acre and corresponding normal basal area.

Modified conventional by volume.—McArdle and Meyer[5] suggested a tentative modification of the conventional method which has been widely used. They proposed, on the basis of limited evidence, that the percentage relationship between actual and normal stand volumes in understocked stands be allowed to approach 100 percent at the rate of 4 percent each decade. Thus a stand which is now 80 percent of normal with respect to volume would presumably have 84 percent of normal volume ten years from now. This proposal has been extended in practice and for this test to include overstocked stands.

Modified conventional by basal area.—This method is almost the same as the one just described. However, in this case the percentage relationship between actual and normal basal areas is increased or decreased toward 100 percent by 4 percent for each ten years in the prediction period and then applied to the yield table volume at some future stand age.

Five-year change in normality.—In 1942 an analysis[6] of data from permanent sample plots indicated that actual stands sometimes grow faster, sometimes slower (depending on present stand age and present stocking) than the conventional application of the normal yield tables allows. Multiple regression equations were developed which provide estimates of the 5-year change in the percentage relationship between actual and normal stand volumes. For Scribner board-foot volume, the multiple regression equation is:

$$X = 33.04 - .131A - .242N$$

Where X = 5 year change in the percentage relationship between actual and normal stand volumes.
A = present stand age.
N = present stand volume as a percent of normal stand volume.

Through the use of this equation, the Scribner volume of a stand can be advanced by 5-year periods.

Average diameter.—More recently average diameter was used as the basis for a method of estimating future stand volumes in young Douglas-fir forests.[7] In this method, site is ignored, but four other types of stand data are required:

[1] Forest Service, U. S. Department of Agriculture.

[2] Eleven of these plots were actually groups of plots. Plots were grouped whenever they had the same establishment date, stand age, site index, and geographic location.

[3] Where stocking is defined as the percentage relationship between actual and normal Scribner volumes per acre existing at establishment date.

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[6] Briegleb, P. A. Progress in estimating trend of normality percentage in second-growth Douglas-fir. Jour. Forestry 40 (10):785-793. 1942.

[7] A more detailed discussion of the average diameter method is available in the appendix to the reference given in footnote 5.

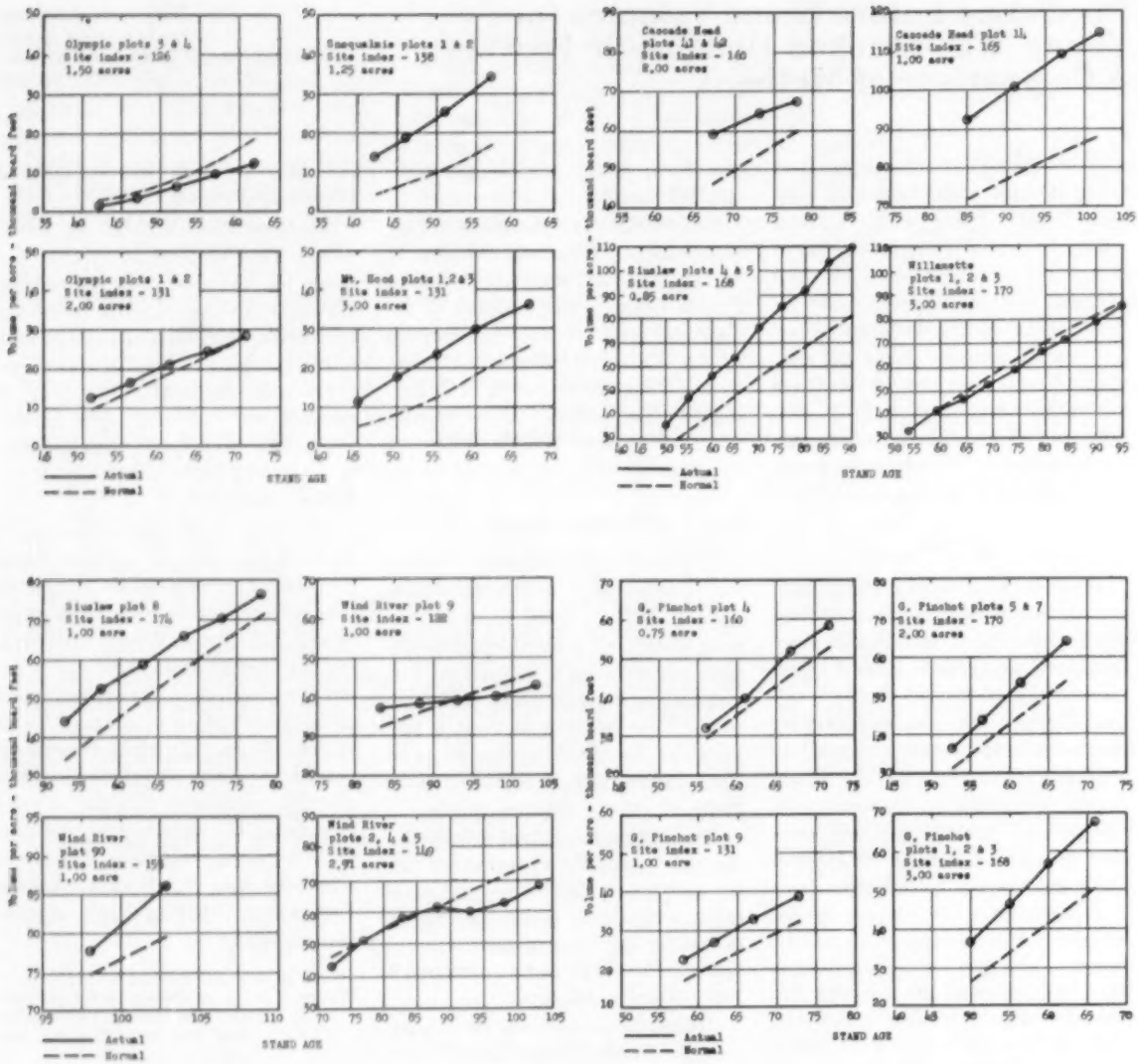

FIG. 1.—Actual and normal Scribner volume per acre over stand age for 17 plots or plot groups.

Table 1.—Differences Between Estimated and Actual Scribner Volumes per Acre by Plot or Plot Group for Seven Prediction Methods

Plot or plot group	Conventional by volume	Conventional by basal area	Modified conventional by volume	Modified conventional by basal area	Five-year change in normality	Average diameter	Normal growth
	Estimated minus actual volume per acre in thousand bd. ft.						
Olympic, 3, 4	−4.0	+5.0	−2.5	+5.2	+3.2	+2.5	+3.6
Olympic, 1, 2	+10.1	−2.1	+7.8	−0.1	+4.3	+8.8	+3.5
Snoqualmie, 1, 2	+18.3	−17.4	+17.3	−17.0	−.6	−1.0	−7.4
Gifford Pinchot, 4	−1.6	−14.4	−4.8	−10.2	−5.9	−4.2	−5.3
Gifford Pinchot, 9	+4.5	−7.0	+2.7	−8.3	−2.4	−4.8	−1.6
Gifford Pinchot, 5, 7	+0.9	−4.1	−2.1	−9.1	−5.7	+1.7	−5.2
Gifford Pinchot, 1, 2, 3	+2.0	−11.4	−1.0	−16.6	−7.6	−3.1	−7.1
Cascade Head, 41, 42	+9.3	−2.5	+6.7	−7.7	+1.2	+5.5	+5.5
Cascade Head, 14	−0.8	−6.1	−6.9	−12.1	−23.1	−15.1	−5.4
Williamette, 1, 2, 3	+0.7	−7.2	+1.2	+1.2	−3.7	+9.5	+1.0
Wind River, 9	+9.8	−1.3	+6.2	+2.3	+0.7	+7.8	+7.6
Wind River, 90	−4.4	−9.7	−6.0	−8.1	−8.4	−4.6	−4.6
Wind River, 2, 4, 5	+3.4	−3.6	+4.7	+4.7	−2.5	+5.5	+4.0
Mt. Hood, 1, 2, 3	+17.7	−11.2	+15.9	−13.2	−5.2	−4.2	−6.1
Siuslaw, 4, 5	−4.9	−9.8	−18.2	−23.2	−27.3	−18.5	−19.3
Siuslaw, 8	+12.7	+2.8	+5.3	−3.1	+1.4	+4.7	+4.7
Siuslaw, 6, 7	+23.8	−8.6	+10.8	−4.7	+0.5	+4.1	+1.0
Average difference	+5.7	−6.4	+2.2	−7.1	−4.8	−0.3	−1.8
Variance	75.1	34.3	77.5	65.3	73.4	62.2	45.0
Standard error	2.1	1.4	2.2	2.0	2.1	1.9	1.6

1. Average number of trees per acre.

2. Average diameter at breast height (weighted by basal area).

3. Average stand age.

4. Heights on about 5 or 10 sample trees which are near the average diameter of the stand.

Present average diameter and present stand age are used to estimate future average diameter. An estimate of future number of trees corresponding to this future average diameter is then found by considering the ratio of present number of trees to present normal number of trees and also by considering a tendency for this ratio to change with time. Estimated future number of trees is then multiplied by an average volume per tree and by a height factor to provide the predicted future stand volume.

Normal growth.—The seventh method tested is based on the assumption that actual stands will put on normal growth. This is tantamount to saying that the curve of Scribner volume per acre over stand age parallels the corresponding curve obtained from the Douglas-fir normal yield tables.

Even a casual examination of Figure 1 is sufficient to indicate the reasonableness of this approach. Although the curves of actual and normal volume over stand age for the permanent sample plots are in no case precisely parallel, the deviations from parallel are not particularly large, and they are about equally divided. In nine cases the curve of actual volume increased more rapidly than a parallel curve. In eight cases the actual curve increased less rapidly. Neither site index nor initial stocking percent seemed to have any effect on whether or not the actual stand grew faster or slower than normal.

Under this method future volumes can be estimated very simply by first determining the difference between future and present normal volumes and then by adding this difference to present actual volume.

Results

The conventional by volume, conventional by basal area, modified conventional by basal area, and 5-year change in normality methods all show some evidence of bias. In each of these cases the average of the 17 differences between estimated and actual volumes departs from zero difference by an amount which is probably larger than can be explained by sampling error alone (Table 1). Average difference is more than twice its standard error for these methods.

Among methods which give no indication of bias, the normal growth method is apparently superior because variation among individual differences was least by this method.

Conclusions

There may be justification here for recommending the normal growth method, at least for stands which do not deviate markedly from normal. There is no evidence that the other methods are more precise, and some of them are definitely more difficult to apply.

It is not unreasonable to suppose that both understocked and overstocked stands can put on normal growth. An understocked stand should experience less suppression mortality and more growth on individual trees than a normal stand. The greater number of trees in an overstocked stand should compensate for the fact that individual trees will grow less and that suppression mortality will undoubtedly be higher.

There are, of course, stocking limits beyond which the normal growth method would not be applicable, but it seems likely that a very large number of Douglas-fir stands would qualify for this method

Statistics from Schools of Forestry for 1954: Degrees Granted and Enrollments

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This article is another in a series of comparable papers appearing annually in the Journal of Forestry since 1934, reporting the enrollment at the schools of forestry and the numbers of degrees conferred. Statistics of this type were first assembled when the Forest Education Inquiry made its study in 1929-1931, and were published in the Inquiry's report in 1932.[1] The annual articles in the Journal have brought to date the figures for each successive year.[2]

THE STATISTICS on degrees granted by schools of forestry in the United States were broken down in 1953 by specialized curricula. This was a new method of reporting which had been discussed for several years but had not been put into use. The presentation met with so much success that it was suggested that the same be done for enrollment statistics this year. After reviewing the curricula of the different schools it was found that there was little segregation during the first two years and in some institutions the forestry freshmen followed a curriculum common to all students. For this reason no attempt has been made to break down the enrollment in the first two years.

For the junior and senior years the same five broad classes used last year in reporting the degrees granted have been used. These are *General Forestry, Wood Technology and Utilization, Range Management, Wildlife Management,* and *Forest Recreation.* Those curricula falling outside of these broad classes have been grouped under the heading *Others.*

While each of these classes was described last year it might be well to outline them again. The statistics grouped together under the heading of *General Forestry* cover those phases of forestry dealing with the growing and harvesting of forest crops. The primary emphasis is placed on the production of the crop and the management of the forest land. Not included are such specialized curricula as "conservation." In the graduate field are included specialization in the fields of forest soils, silviculture, mensuration, protection, economics, valuation, and regulation. Since logging is a phase of harvesting, it has been included under this heading. The curricula in "Forest Engineering" at Oregon State College, and in "Logging Engineering" at the University of Washington have been included here since, in general, they add specialized courses in engineering (both civil and mechanical) to the basic curricula in the "growing and harvesting of forest crops."

The statistics grouped together under the heading of *Wood Technology and Utilization* cover those phases which, though tied into general forestry, are concerned primarily with the wood itself and its utilization. Students following this curriculum are exposed to courses in the growing and harvesting of trees but only in order to get a better understanding of the structure and uses of wood. Not included are specialized curricula in chemical utilization, plastics, pulp and paper manufacture, furniture manufacturing, packaging and similar specializations. These have been grouped under *Others,* along with Conservation Education, Rural Land Use Planning, Soil Conservation, and Light Construction and Lumber Merchandising. *Range Management, Wildlife Management* and *Forest Recreation* are terms which should be self-explanatory.

The only other change is the listing of Louisiana Polytechnic Institute with the twenty-five accredited institutions. It was accredited by the Council of the Society of American Foresters at its meeting in Milwaukee, October 24, 1954, upon recommendation of the Accrediting Committee.

Degrees Granted

During the calendar year 1954 the 35 schools of forestry awarded an estimated 916 undergraduate degrees, 186 masters degrees, and 34 doctors degrees. Of the undergraduate degrees granted, 825 or 90 per-

[1] Graves, H. S. and C. H. Guise, Forest education. Yale Univ. Press, New Haven. 1932.

[2] Guise, C. H. (Eighteen articles on degrees granted and enrollments at schools of forestry in the United States, 1934-1948). Jour. Forestry 32:337-343; 33:402-405; 34:114-120; 35:77-83; 36:12-18; 37:197-202; 38:241-246; 39:359-364; 40:196-202; 41:87-91; 42:357-360; 43:172-175; 44:110-114; 45:174-180; 46:168-173; 47:93-100; 48:165-169; 49:7-12.

Marckworth, Gordon D. Jour. Forestry 50:262-265; 51:256-259; 52:354-358.

TABLE 1.—SIGNIFICANT STATISTICS FOR 1949 THROUGH 1954

	1949	1950	1951	1952	1953	1954
Bachelor's degrees conferred	1,443	2,321	1,564	1,267	1,045	916
Master's degrees conferred	205	275	267	226	151	186
Doctor's degrees conferred	12	29	21	25	37	34
Undergraduates enrolled	7,409	5,935	4,799	4,691	4,909	5,357
Members of freshman class	1,485	1,442	1,370	1,536	1,698	1,986
Members of sophomore class	1,667	1,379	1,107	1,012	1,168	1,377
Members of junior class	1,816	1,384	1,053	1,013	917	1,032
Members of senior class	2,501	1,730	1,269	1,130	1,126	962
Graduate students—master's	450	483	344	281	349	423
Graduate students—doctor's	98	118	137	130	139	127

cent were awarded by the accredited schools compared to 903[3] or 85 percent in 1953, and 1,095 or 86 percent in 1952. Since the present senior class shows a decrease of 14.5 percent over the 1953 senior class, a further decline can be expected in 1955 (Table 1).

Looking at the breakdown of the undergraduate degrees in the specialized fields, we find that 610 of the 916 degrees granted, or 67 percent, were in the field of *General Forestry*. This compares to 72 percent in 1953, and 71 percent in 1952 (Table 2). *Wildlife Management* ranked second with 9 percent and *Wood Technology and Utilization* followed with 7½ percent. Nearly 12 percent of the total number of degrees granted in 1954 were classified as *Others*, compared to 7 percent in 1953 and 5 percent in 1952.[4]

The number of masters degrees conferred in 1954 showed an increase of 23 percent over 1953, increasing from 151 to 186. However, this was 40 less than the 1952 figure of 226. Once again *General Forestry* accounted for the largest number, accounting for 45 percent as it did in 1953. *Wildlife Management* ranked second with approximately 20 percent compared to 26 percent in 1953. The accredited schools granted 179 of the 186 masters degrees conferred in 1954, or 96 percent. Only three nonaccredited schools granted masters degrees and all of these were in the field of *Wildlife Management* (Table 3).

The number of doctor degrees granted dropped from 37 to 34. As in 1953, more than half (53 percent) were in the field of *General Forestry*. All doctor degrees were granted by accredited schools except two in *Wildlife Management* awarded by Virginia Polytechnic Institute (Table 4).

Undergraduate Enrollment

In 1953 the undergraduate enrollment showed an increase for the first time since 1948, increasing from 4,691 in 1952 to 4,909 in 1953. This was an increase of 5 percent. In 1954 the increase was from 4,909 to 5,357 or 9 percent (Table 5). Numerically the increase this year

[3]There is a slight difference between the number of degrees granted in 1953 as reported here and those reported last year due to corrected figures supplied by some of the reporting schools and the inclusion of Louisiana Polytechnic Institute.

[4]There is some difference in the method of classification used by the New York State College of Forestry this year compared to last year, which accounts for part of this difference.

TABLE 2.—BACHELOR DEGREES GRANTED FOR COMPLETION OF STUDIES IN SPECIALIZED FIELDS AT SCHOOLS OF FORESTRY IN THE UNITED STATES—CALENDAR YEARS 1953 AND 1954

Accredited schools	General forestry		Wood technology		Range management		Wildlife management		Forest recreation		Others		Totals	
	1953	1954	1953	1954	1953	1954	1953	1954	1953	1954	1953	1954	1953	1954
Alabama	8	10	2	3	—	—	—	—	—	—	—	—	10	13
California	43	27	—	—	—	—	—	—	—	—	—	—	43	27
Colorado	12	13	3	11	9	9	10	6	8	10	—	1	42	50
Florida	16	13	—	—	—	—	3	2	—	—	—	—	19	15
Georgia	26	36	—	—	—	—	—	—	—	—	—	—	26	36
Idaho	30	20	2	3	9	6	1	2	—	—	—	2	42	33
Iowa	32	23	—	—	—	—	—	—	—	—	—	—	32	23
La. Poly. Inst.	12	9	—	—	—	—	—	—	—	—	—	—	12	9
Louisiana	12	18	2	2	—	—	3	1	—	—	—	—	17	21
Maine	27	32	—	—	—	—	9	11	—	—	—	—	36	43
Massachusetts	5	12	—	—	—	—	11	9	—	—	—	—	16	21
Michigan State	20	26	9	4	—	—	19	19	9	5	27	27	84	81
Michigan Univ.	41	18	10	6	—	—	6	11	—	—	1	4	58	39
Minnesota	35	19	4	8	—	—	—	1	—	—	—	—	39	28
Missouri	11	14	—	—	—	—	—	—	—	—	—	—	11	14
Montana	28	19	—	1	7	5	—	—	—	—	—	—	35	25
New York	61	32	2	—	—	—	—	—	—	—	44	72	107	104
North Carolina	20	23	10	11	—	—	—	—	—	—	1	1	31	35
Oregon	43	29	9	8	—	—	—	—	—	—	—	—	52	37
Pennsylvania	67	51	1	3	—	—	—	—	—	—	—	—	68	54
Purdue	21	20	3	5	—	—	—	—	—	—	—	—	24	25
Utah	10	12	—	—	8	14	11	11	—	—	—	—	29	37
Washington Univ.	36	35	11	4	—	—	—	—	—	—	—	—	47	39
West Virginia	17	14	—	—	—	—	6	2	—	—	—	—	23	16
Total	633	525	68	69	33	34	79	75	17	15	73	107	903	825
Schools not accredited														
Arkansas	10	14	—	—	—	—	—	—	—	—	—	—	10	14
Connecticut	8	3	—	—	—	—	4	1	—	—	—	—	12	4
Mich. Mining	27	19	—	—	—	—	—	—	—	—	—	—	27	19
New Hampshire	8	—	—	—	—	—	3	—	—	—	—	—	11	—
Oklahoma	27	17	—	—	—	—	—	—	—	—	—	—	27	17
Texas (S.F. Austin)	8	8	—	—	—	—	—	—	—	—	—	—	8	8
Univ. of the South	—	4	—	—	—	—	—	—	—	—	—	—	—	4
Virginia Poly. Inst.	17	12	—	—	—	—	—	—	—	—	—	—	17	12
Washington State	18	8	—	—	—	—	12	5	—	—	—	—	30	13
Total	123	85	—	—	—	—	19	6	—	—	—	—	142	91
Grand total	756	610	68	69	33	34	98	81	17	15	73	107	1,045	916

TABLE 3.—MASTER DEGREES GRANTED FOR COMPLETION OF STUDIES IN SPECIALIZED FIELDS AT SCHOOLS OF FORESTRY IN THE UNITED STATES—CALENDAR YEARS 1953 AND 1954

Accredited schools	General forestry		Wood technology		Range management		Wildlife management		Forest recreation		Others		Totals	
	1953	1954	1953	1954	1953	1954	1953	1954	1953	1954	1953	1954	1953	1954
Alabama	1	1	—	—	—	—	—	—	—	—	—	—	1	1
California	4	4	—	—	—	—	—	—	—	—	—	—	4	4
Colorado	—	1	—	—	1	1	3	5	—	—	—	—	4	7
Duke	6	12	—	5	—	—	—	—	—	—	—	—	6	17
Florida	1	1	—	2	—	—	1	—	—	—	—	—	2	3
Georgia	1	3	—	—	—	—	—	—	—	—	—	—	1	3
Idaho	2	4	—	1	—	3	2	4	—	—	—	1	4	13
Iowa	1	2	—	—	—	—	—	—	—	—	—	—	1	2
Louisiana	2	—	—	—	—	—	2	3	—	—	—	—	4	3
Maine	—	—	—	—	—	—	1	2	—	—	—	—	1	2
Massachusetts	—	—	—	—	—	—	2	2	—	—	—	—	2	2
Michigan State	3	4	1	2	—	—	8	4	—	4	—	—	12	14
Michigan Univ.	14	5	—	5	—	—	7	3	—	—	14	4	35	17
Minnesota	4	2	—	1	—	—	—	—	—	—	—	—	4	3
Missouri	1	1	—	—	—	—	—	—	—	—	—	—	1	1
Montana	3	2	—	—	—	—	1	—	—	—	—	—	4	2
New York	2	2	1	—	—	—	—	—	—	—	16	22	19	24
North Carolina	3	3	—	5	—	—	—	—	—	—	—	—	3	8
Oregon	3	8	1	1	—	—	—	—	—	—	—	—	4	9
Pennsylvania	1	4	—	1	—	—	1	3	—	—	—	—	2	8
Purdue	—	1	—	1	—	—	—	—	—	—	—	—	—	2
Utah	—	—	—	—	5	1	7	4	—	—	—	—	12	5
Washington Univ.	4	9	1	—	—	—	—	—	—	—	—	—	5	9
Yale	12	15	3	5	—	—	—	—	—	—	—	—	15	20
Total	68	84	7	29	6	5	35	30	—	4	30	27	146	179
Schools not accredited														
Connecticut	—	—	—	—	—	—	1	2	—	—	—	—	1	2
Virginia Poly. Inst.	—	—	—	—	—	—	4	3	—	—	—	—	4	3
Washington State	—	—	—	—	—	—	—	2	—	—	—	—	—	2
Total	—	—	—	—	—	—	5	7	—	—	—	—	5	7
Grand total	68	84	7	29	6	5	40	37	—	4	30	27	151	186

TABLE 4.—DOCTOR DEGREES GRANTED FOR COMPLETION OF STUDIES IN SPECIALIZED FIELDS AT SCHOOLS OF FORESTRY IN THE UNITED STATES—CALENDAR YEARS: 1953 AND 1954

Accredited schools	General forestry		Wood technology		Wildlife management		Others		Total	
	1953	1954	1953	1954	1953	1954	1953	1954	1953	1954
California	1	1	—	—	—	—	—	—	1	1
Duke	7	2	1	—	—	—	—	—	8	2
Michigan State	2	2	1	—	2	—	—	—	5	2
Michigan Univ.	7	2	—	1	1	2	7	—	15	5
Minnesota	—	1	—	—	—	—	—	—	—	1
New York	2	2	—	1	—	—	3	5	5	8
Purdue	—	1	—	—	—	—	—	—	—	1
Washington Univ.	1	2	—	1	—	—	—	—	1	3
Yale	2	5	—	4	—	—	—	—	2	9
Total	22	18	2	7	3	2	10	5	37	32
Schools not accredited										
Va. Poly. Inst.	—	—	—	—	—	2	—	—	—	2
Grand total	22	18	2	7	3	4	10	5	37	34

is twice that in 1953—448 and 218 respectively.

The increase this year has been brought about by increases in the freshman, sophomore, and junior classes, which totalled 612. On the other hand, the senior class dropped 164 from 1,126 to 962. (Table 6). This is the smallest senior class since 1947 and continues the decline in the senior class which began in 1950. However, with the increased enrollment in the junior class, next year's senior class should show an increase.

Looking at the breakdown by specialized curricula we find that *General Forestry* accounted for 67 percent of the junior and 68 percent of the senior enrollment (Table 7). These percentages coincide with the percentage of undergraduate degrees granted in *General Forestry* in 1954, namely 67 percent. On the basis of these figures we can expect during the next two years that about two-thirds of the bachelor degrees will be granted in the field of *General Forestry*.

Wood Technology and Utilization accounted for 11 percent of the juniors and 12 percent of the seniors, while *Wildlife Management* totalled 9 and 8 percent respectively. *Range Management* accounted for only 3 percent of each class.

Assuming the same trends now evident, all undergraduate classes should show an increase next year of at least 10 percent. This would mean a total enrollment of approximately 6,000, or a few more than we had in 1950.

The number of women enrolled throughout the nation continues to be insignificant. This year there were 17, compared to 16 last year, and 10 in 1952. The distribution by classes for the past five years is shown in Table 8.

Graduate Enrollment

Last year graduate enrollment was confined to 24 accredited and 2 nonaccredited schools. This year there are again 24 accredited schools offering graduate work, but the number of nonaccredited schools has increased in both master's and doctor's degrees. It is interesting to note that the graduate enrollment in the nonaccredited schools is all in *Wildlife Management*. Among the accredited schools 185 of the 414 master's candidates are enrolled in *General Forestry* (45 percent) 62 in *Wildlife Management* (15 percent); 55 in *Wood Technology and Utilization* (13 percent); and 19 in *Range Management* (5 percent) (Table 9).

The enrollment for the doctorate shows 33 percent in *General Forestry;* 18 percent in *Wood Technology and Utilization*, and 14 percent in *Wildlife Management*.

Of the 550 graduate students enrolled throughout the nation only 2 were women, both candidates for the master's degree in *General Forestry*.

Summary

The decline in enrollment which began in the 1949-1950 scholastic year was finally stopped last year when there was an increase of 5 percent over the previous year. As predicted last year, the upswing has continued and the increase this year totals 7 percent. This year the freshman, sophomore, and junior classes all show an increase in enrollment, while the senior class showed a further decline. Two-thirds of the enrollment in the junior and senior classes is in *General Forestry*.

The master's candidates increased from 349 in 1953 to 423 in 1954, while the candidates for the doctorate decreased from 139 to 127. Of the total graduate enrollment 227 or 41 percent are in *General Forestry;* 89 or 16 percent in *Wildlife Management*, and 78 or 14 percent in *Wood Technology and Utilization*.

From 1900 through 1954 there have been 22,493 undergraduate degrees granted in the United States. In addition there have been 3,950 master's degrees and 329 doctor's degrees granted (Table 10).

Table 5.—Enrollment by Classes at Schools of Forestry in the United States for the Fall Term 1954-55

Accredited Schools	Freshmen	Sophomore	Junior	Senior	Total undergraduates	Graduates Masters	Graduates Doctors
Alabama	42	23	14	12	91	4	—
California	16	31	25	25	97	11	6
Colorado	187	91	54	50	382	23	—
Duke	—	—	—	—	—	25	7
Florida	45	34	12	13	104	3	—
Georgia	67	42	31	32	172	9	1
Idaho	74	65	27	29	195	23	—
Iowa	70	42	31	35	178	5	3
La. Poly. Inst.	26	11	10	9	56	—	—
Louisiana State	36	32	36	12	116	6	—
Maine	86	57	35	35	213	2	—
Massachusetts	35	22	32	26	115	6	—
Mich. State Col.	145	97	94	103	439	39	19
Michigan Univ.	25	19	34	38	116	55	15
Minnesota	60	51	35	23	169	10	8
Missouri	54	40	16	21	131	1	—
Montana	102	63	44	45	254	10	—
New York	164	151	115	100	530	53	40
North Carolina	80	50	27	34	191	11	2
Oregon	102	92	49	53	296	14	—
Pennsylvania	96	54	61	56	267	14	—
Purdue	33	38	25	33	129	10	1
Utah	75	40	30	23	168	27	8
Wash. Univ.	94	46	49	39	228	13	8
West Virginia	43	37	18	23	121	—	—
Yale	—	—	—	—	—	40	5
Total	1,757	1,228	904	869	4,758	414	123
Schools not accredited							
Arkansas	35	16	10	11	72	—	—
Connecticut	9	5	13	14	41	2	—
Mich. Mining	38	44	21	19	122	—	—
New Hampshire	36	15	11	8	70	1	—
Oklahoma	34	27	30	15	106	—	—
Texas (S. F. Austin)	25	5	8	5	43	—	—
Univ. of South	6	5	6	3	20	—	—
Va. Poly. Inst.	17	15	16	8	56	3	2
Wash. State Col.	29	17	13	10	69	3	2
Total	229	149	128	93	599	9	4
Grand total	1,986	1,377	1,032	962	5,357	423	127

Table 6.—Undergraduate Fall-Term Enrollments by Classes in Schools of Forestry in the United States for the Years 1944-1945 through 1954-1955

Academic years	—Freshmen— Enrollment	Change	—Sophomores— Enrollment	Change	—Juniors— Enrollment	Change	—Seniors— Enrollment	Change	—Totals— Enrollment	Change
1944-1945	321	+ 122	114	+ 20	64	— 37	72	— 37	571	+ 68
1945-1946	840	+ 519	315	+ 201	205	+ 141	113	+ 41	1,473	+ 902
1946-1947	3,611	+2,771	1,840	+1,525	914	+ 709	645	+ 532	7,010	+5,537
1947-1948	2,061	—1,550	2,878	+1,038	1,577	+ 663	938	+ 293	7,454	+ 444
1948-1949	1,851	— 210	2,178	— 700	2,497	+ 920	1,686	+ 748	8,212	+ 758
1949-1950	1,485	— 366	1,667	— 511	1,816	— 681	2,501	+ 815	7,469	— 743
1950-1951	1,442	— 43	1,379	— 288	1,384	— 432	1,730	— 771	5,935	—1,534
1951-1952	1,370	— 72	1,107	— 272	1,053	— 331	1,269	— 461	4,799	—1,136
1952-1953	1,536	+ 166	1,012	— 95	1,013	— 40	1,130	— 139	4,691	— 108
1953-1954	1,698	+ 162	1,168	+ 156	917	— 96	1,126	— 4	4,909	+ 218
1954-1955	1,986	+ 288	1,377	+ 209	1,032	+ 115	962	— 164	5,357	+ 448

TABLE 7.—ENROLLMENT OF JUNIOR AND SENIOR STUDENTS IN SPECIALIZED FIELDS AT SCHOOLS OF FORESTRY IN THE UNITED STATES FOR THE FALL TERM 1954-55

Accredited schools	General forestry		Wood technology		Range management		Wildlife management		Forest recreation		Others		Total	
	Junior	Senior	Junior	Senior	Junior	Senior	Junior	Senior	Junior	Senior	Junior	Senior	Junior	Senior
Alabama	13	12	1	...	...	...	...	...	...	...	...	...	14	12
California	25	25	...	...	...	...	...	...	...	...	...	...	25	25
Colorado	12	16	7	7	9	12	10	6	6	6	10	3	54	50
Florida	12	12	...	...	...	...	...	1	...	...	...	...	12	13
Georgia	27	26	...	...	...	...	4	6	...	...	...	...	31	32
Idaho	12	19	4	1	6	3	4	6	...	...	1	...	27	29
Iowa	16	23	13	12	2	...	...	...	...	...	...	...	31	35
La. Poly. Inst.	10	9	...	...	...	...	...	...	...	...	...	...	10	9
La. State Univ.	23	8	5	3	...	...	8	1	...	...	...	...	36	12
Maine	27	30	...	...	...	...	8	5	...	...	...	...	35	35
Massachusetts	21	17	...	...	...	...	11	9	...	...	...	...	32	26
Mich. State College	29	31	10	12	...	...	14	17	2	11	39	32	94	103
Michigan Univ.	23	26	4	4	...	...	1	6	...	...	6	2	34	38
Minnesota	20	10	10	11	...	...	5	2	...	...	...	...	35	23
Missouri	14	18	...	...	...	...	...	...	...	...	2	3	16	21
Montana	36	28	2	2	4	9	2	4	...	1	...	1	44	45
New York	52	47	27	22	...	...	...	...	...	...	36	31	115	100
North Carolina	23	23	4	9	...	...	...	...	...	...	...	2	27	34
Oregon	46	44	3	9	...	...	...	...	...	...	...	...	49	53
Pennsylvania	51	54	10	2	...	...	...	...	...	...	...	...	61	56
Purdue	23	27	2	6	...	...	...	...	...	...	...	...	25	33
Utah	12	10	...	...	7	4	8	7	...	...	3	2	30	23
Washington Univ.	38	34	11	5	...	...	...	...	...	...	...	...	49	39
West Virginia	13	18	3	5	...	...	2	...	...	...	...	...	18	23
Total	578	567	116	110	28	28	77	70	8	18	97	76	904	869
Schools not accredited														
Arkansas	10	11	...	...	...	...	...	...	...	...	...	...	10	11
Connecticut	6	12	...	...	...	...	7	2	...	...	...	...	13	14
Mich. Mining	21	19	...	...	...	...	...	...	...	...	...	...	21	19
New Hampshire	6	5	...	...	...	...	5	3	...	...	...	...	11	8
Oklahoma	30	15	...	...	...	...	...	...	...	...	...	...	30	15
Texas (S. F. Austin)	8	5	...	...	...	...	...	...	...	...	...	...	8	5
University of South	6	3	...	...	...	...	...	...	...	...	...	...	6	3
Virginia Poly Inst.	16	8	...	...	...	...	...	...	...	...	...	...	16	8
Washington State Col.	8	5	...	...	1	2	4	3	...	...	...	...	13	10
Total	111	83	...	...	1	2	16	8	...	...	...	...	128	93
Grand Total	689	650	116	110	29	30	93	78	8	18	97	76	1,032	962

TABLE 8.—UNDERGRADUATE FALL TERM ENROLLMENT OF WOMEN IN SCHOOLS OF FORESTRY IN THE UNITED STATES FOR THE YEARS 1950 THROUGH 1954

Class	1950	1951	1952	1953	1954
Freshman	2	...	5	8	7
Sophomore	...	4	2	5	6
Junior	1	...	3	...	3
Senior	4	1	2	3	1
Total	7	5	10	16	17

TABLE 9.—ENROLLMENT OF GRADUATE STUDENTS IN SCHOOLS OF FORESTRY IN THE UNITED STATES FOR THE FALL TERM 1954-1955

Accredited schools	General forestry		Wood technology		Range management		Wildlife management		Forest recreation		Others		Total	
	Master	Doctor	Master	Doctor	Master	Doctor	Master	Doctor	Master	Doctor	Master	Doctor	Master	Doctor
Alabama	3	—	1	—	—	—	—	—	—	—	—	—	4	—
California	11	6	—	—	—	—	—	—	—	—	—	—	11	6
Colorado	6	—	—	—	5	—	7	—	3	—	2	—	23	—
Duke	18	5	7	2	—	—	—	—	—	—	—	—	25	7
Florida	1	—	—	—	—	—	2	—	—	—	—	—	3	—
Georgia	9	1	—	—	—	—	—	—	—	—	—	—	9	1
Idaho	7	—	2	—	5	—	7	—	—	—	2	—	23	—
Iowa	4	—	1	—	—	—	—	—	—	—	—	3	5	3
La. State Univ.	2	—	—	—	—	—	4	—	—	—	—	—	6	—
Maine	—	—	—	—	—	—	2	—	—	—	—	—	2	—
Massachusetts	—	—	—	—	—	—	6	—	—	—	—	—	6	—
Michigan State	9	9	3	3	—	—	12	7	4	—	11	—	39	19
Michigan Univ.	18	3	8	2	—	—	6	2	—	—	23	8	55	15
Minnesota	7	6	3	2	—	—	—	—	—	—	—	—	10	8
Missouri	1	—	—	—	—	—	—	—	—	—	—	—	1	—
Montana	4	—	—	—	2	—	1	—	—	—	3	—	10	—
New York	9	1	1	11	—	—	—	—	—	—	43	28	53	40
North Carolina	5	1	6	1	—	—	—	—	—	—	—	—	11	2
Oregon	12	—	2	—	—	—	—	—	—	—	—	—	14	—
Pennsylvania	6	—	7	—	—	—	1	—	—	—	—	—	14	—
Purdue	6	1	1	—	—	—	1	—	—	—	2	—	10	1
Utah	7	—	—	—	7	3	13	5	—	—	—	—	27	8
Washington Univ.	11	5	2	1	—	—	—	—	—	2	—	—	13	8
Yale	29	4	11	1	—	—	—	—	—	—	—	—	40	5
Total	185	42	55	23	19	3	62	14	7	2	86	39	414	123
Schools not accredited														
Connecticut	—	—	—	—	—	—	2	—	—	—	—	—	2	—
New Hampshire	—	—	—	—	—	—	1	—	—	—	—	—	1	—
Va. Poly. Inst.	—	—	—	—	—	—	3	2	—	—	—	—	3	2
Washington State	—	—	—	—	—	—	3	2	—	—	—	—	3	2
Total	—	—	—	—	—	—	9	4	—	—	—	—	9	4
Grand total	185	42	55	23	19	3	71	18	7	2	86	39	423	127

TABLE 10—NUMBER OF DEGREES GRANTED FOR COMPLETION OF STUDIES AT SCHOOLS OF FORESTRY IN THE UNITED STATES FOR THE CALENDAR YEARS 1900-1954

Years	Undergraduate degrees	Master's degrees	Doctor's degrees
1900	1	—	
1901	5	—	
1902	2	9	
1903	3	14	
1904	9	29	
1905	9	34	
1906	24	24	
1907	19	27	
1908	31	35	
1909	47	44	
1910	61	48	
1911	100	61	
1912	122	54	
1913	136	37	
1914	151	42	
1915	124	35	
1916	151	36	
1917	160	27	
1918	65	10	
1919	53	6	
1920	160	25	
1921	126	26	
1922	141	44	
1923	217	31	
1924	215	43	
1925	280	44	
1926	259	58	
1927	263	50	
1928	302	64	
1929	291	54	
1930	308	69	
1931	394	97	(34)[1]
1932	380	78	7
1933	355	65	6
1934	337	47	6
1935	423	58	8
1936	502	67	9
1937	803	75	7
1938	980	95	5
1939	1,102	112	8
1940	1,072	105	9
1941	834	117	12
1942	654	76	13
1943	446	28	6
1944	106	12	3
1945	51	18	7
1946	192	65	8
1947	553	223	7
1948	918	222	16
1949	1,443	205	12
1950	2,321	275	29
1951	1,564	267	21
1952	1,267	226	25
1953	1,045	151	37
1954	916	186	34
Total	22,493	3,950	329

[1]Total doctor's degrees granted prior to 1932. Break-down by years not available.

The Effects of an Artificially Induced Drought on Shortleaf Pine

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THE QUESTION of "what are the symptoms of drought in southern pines" has been the subject of some controversy. Furthermore, prolonged droughts have been suggested by some as a possible cause of the littleleaf disease of shortleaf pine (*Pinus echinata* Mill.). Therefore, an experiment was undertaken to determine the effects of reduced soil moisture on the growth and behavior of shortleaf pines in the field, and to determine whether drought will produce the symptoms of littleleaf. Recent research has shown that the fungus *Phytophthora cinnamoni* Rands is largely responsible for the high mortality among the fine roots of shortleaf pine affected with littleleaf.[2]

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[2]Campbell, W. A., Otis L. Copeland, Jr., and George H. Hepting. Managing shortleaf pine in littleleaf disease areas. Southeastern Forest Experiment Station Paper No. 25. 12 pp. 1953.

The Study

A rectangular shelter, 26 x 62 feet, was constructed of lumber and covered with roll roofing around six healthy 35-year-old shortleaf pine trees to partially dessicate the soil and thereby create a moisture stress (Fig. 1). The trees were located on a well-drained Cecil sandy loam soil on the Calhoun Experimental Forest, near Union, S. C. The elevation of the shelter above the surface of the soil was four feet on the higher side sloping to one foot on the lower side, to provide both air circulation above the covered soil and rapid removal of rainfall from the surface of the shelter. The roofing was fitted closely to the individual trees to minimize the amount of precipitation reaching the soil at the base of each tree. A sheet-metal trough extended the length of the shelter on the lower side to catch and discharge all rainfall-runoff from the surface of the shelter. A perimeter trench, 18 inches wide and 24 to 30 inches deep, surrounded the plot under the eaves of the shelter to restrict the upper lateral roots to the covered plot and also to intercept and discharge any surface runoff from the area adjacent to the covered plot. Construction of the shelter was completed in April 1948.

FIG. 1.—A view of the shelter, showing its construction around the trees subjected to the prolonged drought. Three trees that died have been removed and the holes have been capped.

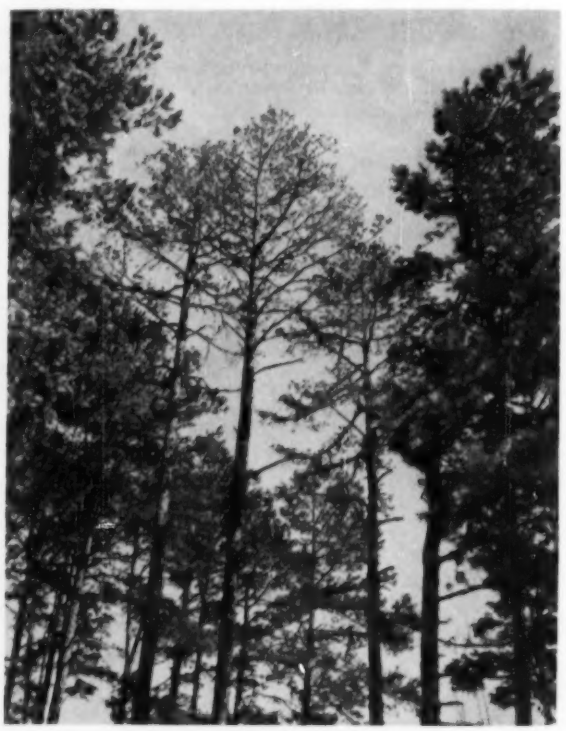

FIG. 2.—A view of the trees subjected to the prolonged artificially induced drought, showing numerous dead lower branches and tufted sparse crowns. Healthy shortleaf pine trees are adjacent to the experimental plot.

Results

Trees numbered 1, 2, and 3 were attacked by turpentine beetles in 1948. These trees died the following year. Death was attributed to the severe beetle attack. The remaining three trees were still living in 1953, although growth has almost ceased.

On each of the three trees that died, needles on the lower branches first turned yellowish-brown, changing to a pronounced brown color at the time of death. As each of the trees declined, branches died from the bottom of the crown upward. When approximately one-half of the lower crown had died, the remainder of the crown turned brown and death followed immediately.

The simulated drought has caused pronounced growth reduction in trees numbered 4, 5, and 6, which is most evident in the crowns. Lower branches have died, one by one, until the remaining crowns are only about half their original size. Buchanan[3] concluded that drought injury causes the death of branches from the top of the crown downward, a conclusion not substantiated by the results of this experiment. Figure 2 shows numerous dead branches in the lower portion of the crowns but no dead branches in the upper crowns. The photograph affords a comparison of the foliage on the trees subjected to the prolonged drought with foliage of normal healthy trees outside of the plot. The crowns of the trees surrounded by the shelter are sparse. Needles that were 3 to 4 inches long at the beginning of the experiment have been reduced to 1 to 2 inches in length. Needle retention along the twigs, usually extending 7 inches or more back from the tips, has been reduced to 2 to 3 inches, giving the crowns a thin tufted appearance. Measurements of trunk diameters, needle lengths, and the mean length of the needle-bearing portions of the shoots are presented in Table 1. The data show little or no diameter growth and progressive reduction in needle length and needle retention along the twigs during the course of the experiment.

TABLE 1.—TRUNK DIAMETERS, NEEDLE LENGTHS, AND LENGTHS OF NEEDLE-BEARING PARTS OF SHOOTS OF THE UNTREATED AND TREATED TREES AT VARIOUS TIMES DURING THE EXPERIMENT

Tree number	D.b.h. Apr. 1948	D.b.h. Apr. 1953	Needle length Apr. 1948	Needle length Aug. 1948	Needle length Oct. 1950	Needle length Apr. 1953	Mean length of needle-bearing part of shoot Apr. 1948	Mean length of needle-bearing part of shoot Aug. 1948	Mean length of needle-bearing part of shoot Oct. 1948	Mean length of needle-bearing part of shoot Apr. 1948
	Inches									
UNTREATED										
1	12.0	12.7	4	4	4	4	8	8	9	9
2	12.0	12.6	3½	3½	3	3	8	8	8	8
3	11.6	12.2	4	4	4	4	12	12	12	12
TREATED (Soil covered and trenched)										
1	10.5	Dead	4	3	Dead		8	8	Dead	
2	9.8	Dead	3½	3	Dead		8	8	Dead	
3	10.1	Dead	3½	3	Dead		8	8	Dead	
4	11.4	11.5	3½	3	2	2	8	8	4	3
5	10.0	10.0	3½	3	2	2	9	9	3	3
6	9.9	9.9	4	3½	2	2	8	8	4	2

Chlorosis of needles, a characteristic symptom of littleleaf-diseased trees caused by low nitrogen uptake, has not developed on the trees subjected to the moisture stress. Results of nitrogen analyses of needles collected at three different times from the treated and control trees are presented in Table 2. These data indicate that nitrogen uptake by the trees under the severe moisture stress has proceeded at a normal level, showing a slight increase from 0.97 percent in 1948 to 1.05 percent in 1953. For the same period, the trees outside of the plot increased from an average of 1.13 percent to 1.29 percent of nitrogen. This normal nitrogen content of the needles on the trees exposed to drought conditions fails to support the suggestion that drought is the cause of littleleaf, since Roth et. al.[4] showed that the nitrogen content of needles from healthy shortleaf pines is much greater than that in needles of littleleaf-diseased trees. They found that the nitrogen content of needles from healthy shortleaf pine in non-littleleaf Piedmont stands averaged 1.03 percent over a 3-year period while for severe littleleaf trees the nitrogen content of the needles averaged only 0.66 percent.

TABLE 2.—NITROGEN CONTENT OF NEEDLES OF THE UNTREATED AND TREATED TREES DURING THE COURSE OF THE EXPERIMENT

Tree number	Nitrogen content of needles (oven-dry weight basis) 1948	1951	1953
UNTREATED	*Percent*		
1	1.09	1.20	1.26
2	0.98	1.05	1.32
3	1.32	1.28	1.28
Average	1.13	1.18	1.29
TREATED (Soil covered and trenched)			
1	1.14	Dead	Dead
2	1.00	Dead	Dead
3	1.03	Dead	Dead
4	1.05	1.14	1.27
5	0.89	1.02	0.95
6	0.98	0.95	0.93
Average	0.97[1]	1.04	1.05

[1]Excluding trees 1, 2, and 3.

Data on soil moisture contents (oven-dry basis) are presented in Table 3. Usually, the soil was drier under the shelter than outside, but during extreme natural droughts, soil moisture outside of the shelter was lower than under the shelter because of the greater competition for moisture by the surrounding dense pine stand. This condition is reflected in the October 1950 sampling. An example of the effectiveness of the shelter and perimeter trench in reducing soil moisture is shown by the April 1952 sampling. At all depths sampled at that time, the covered soil was drier than that not covered. At the 25-to-30-inch depth, there was little difference in moisture content of

[3]Buchanan, T. S. Characteristics of the littleleaf disease of southern pines. Yale Univ. Doctorate Thesis. 205 pp. 1943.

[4]Roth, Elmer R., E. Richard Toole, and George H. Hepting. 1948. Nutritional aspects of the littleleaf disease of pine. Jour. Forestry 46:578-587.

TABLE 3.—MOISTURE CONTENT OF SOIL UNDER THE SHELTER AND IN OUTSIDE AREA EXPRESSED AS PERCENT OVEN-DRY WEIGHT AT DIFFERENT SAMPLING DATES

	January 1950		October 1950		April 1952		June 1953	
Depth	Under shelter	Outside	Under shelter	Outside	Under shelter	Outside	Under shelter	Outside
Inches				*Percent*				
0-6	10.0	12.6	4.0	3.8	4.6	17.9	2.7	6.6
7-12	18.3	16.5	17.0	11.8	16.5	20.3	13.2	12.6
13-18	20.9	22.9	22.2	17.8	23.5	29.0	21.2	20.3
19-24	17.7	23.1	20.5	21.7	21.2	28.6	19.0	24.0
25-30	16.3	22.8	19.8	15.2	26.1	27.9	15.5	22.3
31-36	15.1	20.1	16.1	13.5	17.6	28.6	14.6	17.3
37-42	13.4	21.4	14.5	13.5	16.5	28.2	12.9	18.0
43-48	13.4	20.3	14.0	....	14.5	26.7	13.2	23.3
49-54	....	....	12.8	....	13.3	26.2	12.6	20.6
55-60	....	....	12.7	....	11.9	23.7	10.8	18.4
61-66	....	....	11.8	....	11.5	23.7	11.4	18.5
67-72	....	....	10.2	....	11.1	22.5	10.2	21.4

the two areas. This depth coincides with the bottom of the perimeter trench. Soil moisture samplings indicated that the moisture content of the covered plot fluctuated from season to season, as did the soil outside, but generally the moisture content of the covered plot remained at a significantly lower level during the experiment. This is especially true for depths below 30 inches, where the moisture content of the covered soil remained very close to the same level during the experiment.

Conclusion

This experiment brings out the specific effects of a soil moisture deficit on shortleaf pine. A lack of moisture curtails diameter growth, shoot growth, and needle length. Needle color is unaffected by a prolonged moisture stress. Although nitrogen uptake remained at a normal level on a percentage basis, reduction in crown density results in an overall decrease in total uptake. Branch-dying, caused by a prolonged drought, begins at the base of the crown and slowly proceeds upward, eventually producing a much smaller crown than that originally possessed by the tree.

❦❦❦

American Men of Science

The second volume of *American Men of Science,* devoted to biological sciences, is now being compiled. Jaques Cattell, the editor, invites those readers of this JOURNAL who are actively engaged in the profession of forestry to request blanks from him at The Science Press, Box 749, Lancaster, Pa., if they think they qualify for inclusion. A Ph.D. degree is desirable but not essential; active research is. Mr. Cattell is especially eager to hear from members of industrial organizations who are engaged in research programs.

American Men of Science, now in its ninth edition, is jointly published by The Science Press and the R. R. Bowker Company, of New York City.

Air-Layering of Slash Pines[1]

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ONE OF THE IMPORTANT factors contributing to failure to root development in slash pine cuttings is the shock which cuttings sustain when removed from the tree. Large amounts of reserve carbohydrates and other nutrients are needed to form the callus tissue and to develop the roots. Once a cutting is severed from the tree, it has to rely on the nutrients stored before it was severed.

In air-layering, the branches are not removed from the tree, but roots are induced to form on the branches while they are still a part of the parent plant. After the roots have developed, the branch bearing these roots is severed from the original plant and handled as a separate individual. As in any other asexual method of propagation, layering reproduces a plant with the identical genotype of the original plant.

This study was carried out to find out whether or not the air-layering of slash pine branches is physiologically possible. No previous attempt in America to reproduce pines by air-layering has been reported. The successful use of the method on slash pine, as reported in this paper, indicates that the technique has real promise for extension to other species which are difficult to propagate by cuttings.

Review of Literature

Vegetative propagtion by layering induces root formation on the branch while it is still attached to the plant. In nature, layering occurs in a large number of gymnosperms (*1, 2, 7, 16*) when lateral branches become covered by mineral soil, moist litter, or moss. Natural layering of slash pine branches apparently has not yet been observed in the field, and as far as the writer is aware only one instance of natural layering of pine in America has been reported (*7*). In his discussion of an isolated occurrence of a rooted basal branch of eastern white pine, Lutz considered the intolerance of most pines to shade as a possible explanation for this rare occurence. In pines, the basal branches ordinarily die before they become covered with organic debris. Slash pine trees growing along margins of old fields occasionally have several of their basal branches covered by litter, but no natural rooting occurs.

In layering, the stem or branch is usually wounded by girdling or by scraping the cambium to inhibit the free movement of plant solutes. The wounding is done either by completely removing a ring of bark or by cutting a tonque which can be kept from healing by inserting a piece of wood (*17*). If the wound is covered with moist sandy soil, roots will develop in many plant species.

A method of layering where roots are induced to form on a place not in contact with the ground has been in use by the Chinese for some 20 centuries. It is known to the horticulturists as air-layering, Chinese layering, marcottage, mossing off, or vegetative propagation from gootes (*12, 17*). A handful of moist sphagnum moss or other moisture-holding material is placed around the stem where the wound is made and is covered over by moisture-proof wrappings.

During 1940 and 1941, Lasschuitt (*5*) was able to stimulate adventive root formation of *Pinus merkusii* by marcottage. This species of pine grows in the tropical forests of Sumatra and occasionally produces spontaneous adventive roots in wounded or damaged trees. Lasschuitt reported a "spontaneous" case of rooting in which 30-40 roots had developed along the wound of a split tree fork. Several of these roots had branched and were over 3 feet in length. These observations prompted Lasschuitt to start a rooting study in which he rubbed mechanical wounds with a mixture of leaf-mold and "pine-soil" containing mycorrhiza. Then the wounds were packed with 5-10 kilograms of this mixture, which was kept in place by a mat. These marcottes had to be watered during the dry season. After 8 months, 7 of the wounded branches out of a total of 75 had formed roots.

In air-layering, the medium has to stay moist at all times. Frequent watering of the wrapping was one of the big chores until the newer plastic films became available. Polyethylene films have properties which make them suitable to cover the moisture-holding wrap in air-layers (*18*). Among these desirable properties are the high permeability to gases like oxygen and carbon dioxide, the very low permeability to water vapor, and the transparency of the film. Because of the latter quality the root formation of the twig can be noted without disturbing the wrapping.

Wyman (*18*) presented a large list of plants which root with difficulty but responded well to the air-layer technique. No member of the genus Pinus was included in this list, but several of the forest trees which are considered "difficult" to root as cuttings responded satisfactorily to the air-layering technique. Wyman's experiments, however, had to do only with the formation of visible roots. He did not attempt to solve the problem of cutting the potential plants from the parent and getting them to grow after they were potted. His few attempts to pot these plants were unsuccessful.

Treatment of the wound with growth regulators gave promising results in the air-layering of 2- and 3-year-old mango plants (*12, 13*). Roots were found in the treated regions within 6 weeks of treatment,whereas there was no rooting in the untreated control plants. Root induction on the auxin-treated branches of older mother plants

[1]This article is based on part of a thesis entitled "Rooting and grafting of slash pine (*Pinus elliottii*, Engelm.) for application in forest tree genetics" submitted to the Graduate School of Yale University in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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was successful, but the time taken for root formation was comparatively much longer and the number of roots produced was much less than on the younger trees. The roots which formed on the older trees were quite insufficient for the independent existence of the goote in the soil. In a later study Singh (*10*) succeeded in air-layering shoots from 30-year-old mango trees. The rooted shoots developed normally after they were detached from the mother plant and potted.

Several organizations and institutions have started experiments with this technique since a preliminary report of the result with slash pine was published (*8*), but no results from these studies are available as yet.

Design of Experiment

A total of 52 air-layers were made on 26 slash pines. The first set of 8 was prepared on October 22, 1952, the second group of 20 on May 15, 1953 and the third group of 24 was prepared on August 7, 1953. Only a small sample of plastic wrapping material was available at the beginning of the study, which accounts for the smaller number of attempts in October, 1952. The starting dates were staggered to determine the optimum time of year when air-layering should take place.

To obtain information on the beneficial effect of indolebutyric acid, paired groups were used in the experiment. Relative position of the branch on a tree has a pronounced effect on the rooting response of the branch, and to overcome this difficulty, two branches growing from the same whorl were selected for the comparative air-layering on each tree. One-half of the wounds were treated with indolebutyric acid, while the other half were not given any chemical treatment. The environmental conditions for the two groups were equivalent except for the factor specifically under tests, and the chemical treatment was allotted to the two groups at random.

All air-layering was attempted on natural slash pines between the ages of 5 and 17 years. The branches ranged in diameter from ¼ to ¾ inch and some were up to 24 inches in length.

Air-layering procedure. — Slash pine branches selected for rooting were prepared by first stripping the needle fascicles from the lower part of the branch. A ¼- to ½-inch ring of bark and cambium was removed with a sharp knife at the place where root formation was desired (Fig. 1). The wounded area was scraped clean of any remaining cambium cells. Incomplete removal permits callus material to bridge the wound, thus preventing root formation. The upper rim of the girdle on one-half of the branches was dusted with an 0.8-percent indolebutyric acid mixture in talc (Hormodin No. 3). A handful of moist sphagnum moss was wrapped around the treated part (Fig. 1) and covered with moisture-proof plastic. The moist sphagnum moss was squeezed before it was wrapped around the completely girdled cut. Commercial "Airwrap"[3] was used as covering material in these tests. The film was fastened at the top and bottom with grafting tape (Fig. 1). The plastic film covered the sphagnum moss and no opening was left for the evaporation of moisture from the moss. If properly applied, the moss in the air-layer stayed moist for several months. If drying became noticeable, a little water was added with a hypodermic syringe.

Results and discussion on air-layering.—The results on adventitious root induction are presented in Table 1, where the data have been assembled by time of year and by chemical treatment. The time span for the first root formation is also given. The statistical analysis of the paired data, using a "t" test, indicated a highly significant effect of the indolebutyric acid on the number of roots produced. The average number of roots developed for all attempts, including the unrooted branches, was 5.58 for the treated branches whereas only 1.46

[3] "Airwraps" is a moisture-proof, gas-permeable plastic, treated with a water-soluble emulsion of nutrients, hormones, insecticides, and fungicides.

FIG. 1.—Air layering a slash pine branch. *Left:* A ring of bark and cambium was removed. *Center:* After the wound was scraped clean, a handful of moist sphagnum moss was wrapped around the girdle. *Right:* A moisture-proof, treated plastic sheet was wrapped around the ball of moss and fastened tightly at the two ends with grafting tape.

Table 1.—Effect of indolebutyric acid on root development in air-layered slash pine branches

Date started	Treated with indolebutyric acid			Untreated			Time elapsed for first root development
	Attempted	Rooted	Average roots per branch	Attempted	Rooted	Average roots per branch	
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Weeks*
Oct. 22, 1952	4	3	4.3	4	0	0	23
May 15, 1953	10	8	5.2	10	6	1.6	8
Aug. 6, 1953	12	11	8.1	12	7	4.0	6

roots were produced by the untreated air-layers. A Chi square analysis of the data on number of branches which rooted indicated a beneficial effect of chemical treatment which was significant at the 5-percent level. The data were corrected for continuity before they were subjected to the Chi square analysis procedure.

Average rooting percentage was 84.6 for the treated branches, whereas only 50.0 percent of the untreated branches rooted. The data on number of roots produced are a much better indicator of the effect of treatment, as in many instances the number and quality of roots produced without the indolebutyric acid treatment would not have been sufficient for the branch to stay alive once it had been removed from the plant and potted. The diameter of the roots on the untreated branches was much smaller and the root tips did not appear as vigorous as those of the treated ones.

The branches which were air-layered during October produced the first roots after 23 weeks. These branches became semidormant soon after girdling, and root initiation probably took place at the start of the next growing season.

The first group of air-layers which had been started on October 22 were checked periodically, and the first roots were observed on March 30, 1953, five months after the start of the test. A collar of callus tissue had formed along the upper rim, and ten roots had developed from it. Most of the roots were located along the lower side of the branch (Fig. 2), indicating the polarity of the root-forming substances. Some of the roots were as much as 2 inches in length. They were stiff and stout, and several of the larger roots had started to form side branches. There was no evidence of fungi or other damaging microrganisms around the newly developed roots.

In most air-layers the greater number of roots was on the side receiving the largest amount of sunshine. As light could not penetrate through the wrapping material to the wounded area, it would appear that the higher temperature of the medium was the active factor. As a result of the higher temperature, cell division and cell differentiation were probably stimulated. This in turn resulted in more prolific root development. In rooting experiments, a relatively high temperature of the medium was found to promote a better root system (*9*).

Observation of the bud or shoot development of the air-layered branches frequently indicated the success or failure of the rooting attemps. In one instance, for example, the terminal bud on the branch which had rooted was still in a dormant stage, while a new shoot 6 inches in length had developed on the branch which had not formed roots (Fig. 3). Both branches started from the same whorl on the same tree. Many similar instances were observed, but the example illustrated showed the greatest difference in growth pattern.

It is possible that a growth inhibiting hormone is produced near the callus tissue and translocated to the apical growing point, or that treatment inhibited the buds (*14*). Once the branch was cut from the tree, potted, and watered with liberal doses of a soluble fertilizer mixture, height growth followed without delay. Thus the delayed height growth was probably of a nutritional rather than an auxin nature. The stored food materials had been utilized to develop adventitious roots rather than to add a new shoot. The difference in growth pattern was most pronounced where roots formed only on the branch which had received the indolebutyric acid treatment. This observation is in agreement with Loeb's (*6*) findings regarding the drain of food supply by the new growth. He found the drain of available food supply to be of the same effectiveness for equal amounts of new growth, whether the growth was centered in the shoot or in the roots.

Root formation.—By the periodic examination of the wound surface some insight was gained as to the manner in which the adventive roots were formed. For the most part local swellings occured along the rim of the wound closest to the branch tip. The first callus formation could be observed about 10 days after treatment. At first the swellings appeared as isolated dots but expanded rapidly. Within several weeks they had fused together to form a solid callus rim. The first callus appeared from the phloem region. It was whitish in color and turned brown as suberization occured. The rim closest to the main stem did not add any noticeable growth. It appeared to die rather than develop a protective callus cushion. There was a marked swelling at the basal end of the air-layered branch just above the girdle. White protuberances became noticeable on the upper rim of both the treated and untreated wounds. On the untreated wounds, however, they did not elongate to the same extent as on the treated areas. The chemical substance which brings about differentiation of the callus tissue was probably lacking in the untreated wounds.

White protuberances on the cal-

FIG. 2.—Roots on air-layered slash pine branch. This branch had a total of 10 separate roots, most of which had developed along the lower side of the branch.

FIG. 3.—Comparison of height growth between rooted and unrooted branch. Branch on right-hand side of photograph (still attached to stem) did not root but added 6 inches of height growth (a). The rooted branch on the left grew from the same whorl. It had been treated with indolebutyric acid. The terminal bud remained dormant.

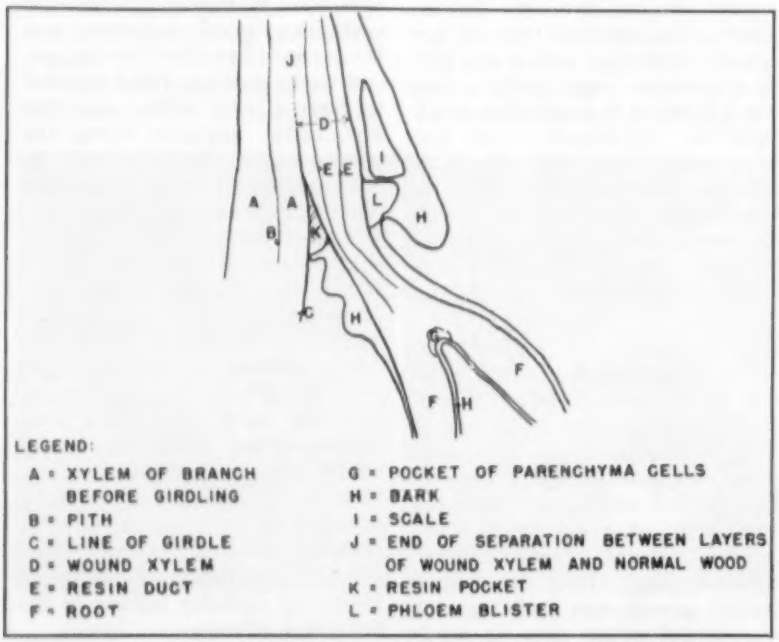

FIG. 4.—Camera lucida drawing of radial section of rooted branch (X10).

lus surface were the first indications of root formation. But not all protuberances of the callus contained root primordia. Some consisted entirely of parenchymatous cells resembling those in the other parts of the callus, while in the other swellings distinct root primordia were visible. The outward appearance of these two types of protuberances was similar and they could only be identified after dissection.

Origin of roots.—In conifers, adventitious roots originate from various sectors of the stem. Ten rooted air-layered branches were dissected to observe the origin of the roots to see if a certain sector of the stem involved a greater number of roots. Bannan (*1*) observed that the adventitious roots of larch originated in the vicinity of dead or injured dwarf branches. In spruce and fir the roots arose from

dormant buds, while in ground hemlock they arose from sectors of the cambium comprising variable numbers of fusiform initials and the intervening ray initials. He made his observations on adventitious roots which had formed spontaneously in nature. Mechanically or chemically stimulated roots probably do not follow such a regular pattern. If, however, most of the roots arose from a certain sector of the slash pine branches, this knowledge would be helpful in preparing the girdle.

Examination of the differentially stained (safranine — fast green — orange G) free-hand sections invariably showed that the roots arose from the basal part of the upper section of the girdle. There were continuous vascular connections between the xylem of the roots and the xylem or secondary tissue of the branch which had been produced by the wood cambium after the girdling. Figure 4 is a camera lucida drawing of a longisection of the root and part of the stem of a rooted air-layered branch. The wood which was laid down just above the girdle of the branch accepted the stain to a degree different from that of the xylem which was present before the branch was injured. This particular type of wood was referred to by Sledge (*11*) as "wound wood." In the sections examined, it contained a large amount of parenchymatous tissue. The longitudinal resin ducts of this newly laid down wood formed continuous canals into the roots.

A comparison of the root origin in air-layered slash pine branches and in rooted cuttings showed great similarity between the two types of root systems. Adventitious roots in cuttings also originated from the wound xylem or callus rim which had formed after the cuttings were placed in the propagation medium. The vascular connections between the roots and the wound xylem were continuous. Figure 5 is a camera lucida drawing of a radial section through the base of a rooted slash pine cutting. The roots on this cutting were 11 months old.

Observations of the early stages of root formation indicated that the roots arising from the newly formed wood are endogenous in origin. They arose in the callus or wound tissue. The endolegenous nature of adventitious roots in pines was described previously by Deuber (*4*) and by Delisle (*3*), but a preliminary report on the callus and adventitious root development in *Pinus densiflora* and *Pinus densiflora* x *Pinus thunbergii* by Toda and Satoo (*15*) indicated an exogenous origin of these roots. The type of root *anlagen* above the wound as illustrated by Delisle (*3*) was not observed in slash pine. They emerged directly from the callus collar and grew downward. Only abortive roots grew from the callus collar at right angles to the branch.

None of the observations indicated that the roots arose from a particular location on the branch. They all originated from the base of the "wound wood" which had been laid down along the lower part of branch above the girdle. This would indicate that the relative position of the girdle is of little consequence as long as it is located in immature tissue which can start prolific cell division and differentiation without delay.

In several instances the amount of auxin powder which was applied to the girdle killed part of the tissue. This did not necessarily interfere with good root formation but the roots were formed above the killed area.

The diameter of the emerging roots was rather large. In some instances it was as much as 5 mm. At first they were whitish in color and at this stage they were ex-

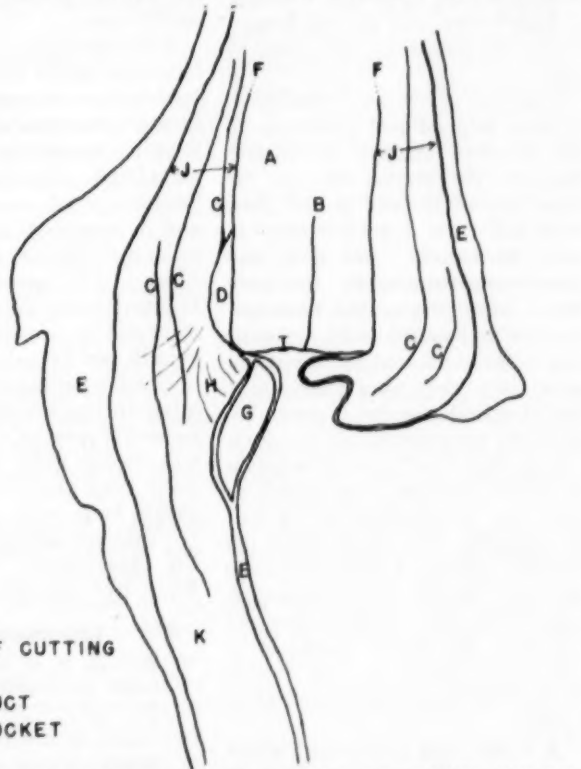

Fig. 5.—Camera lucida drawing of radial section through base of rooted slash pine cutting (X10).

FIG. 6.—Root system of potted air-layered branch. This branch had been potted for a period of 5 months. Root growth was active and mycorrhizae were numerous.

tremely brittle. Later they changed to dark brown and became firmer, having the consistency of an orchid tuber.

Planting of rooted branches.—As soon as good root development was observed through the plastic wrapper, the branch was cut off below the girdle and potted in a loose soil. An equal mixture of sand, vermiculite, and peat was found very suitable for this purpose. After the rooted branches, which were as much as 24 inches in length, were planted in one-gallon metal cans, they were placed in a humid greenhouse for 6 weeks before they were moved into the nursery. A pint of a 3-percent solution of 7-9-19 fertilizer was added to each pot to stimulate rapid root development. The shock which the branches sustained when they were clipped from the tree was apparently small, as root elongation did not stop. In several instances as much as 4 inches of root growth were added within two weeks after potting.

A rooted slash pine branch which was planted during the end of March started height growth without delay, and within five months the root growth had filled the space of a 9-inch clay pot (Fig. 6). This is in contrast to cuttings which develop in propagation frames. The latter have a tendency to develop more slowly in the beginning.

Conclusions

This study has proved that the rooting of slash pine branches by air-layering is physiologically possible. It appears at present that the air-layering method has great possibilities for the vegetative propagation of slash pines. A much greater percentage of rooted branches can be obtained by this method than by bench propagation and advantage can be taken of the root-promoting chemicals. The initial time involved to prepare the branches is greater than when cuttings are rooted in a propagation frame. But once the branches are prepared, they require no care or attention until rooting has occurred. With cuttings, however, the preparation of the benches and the control of the greenhouse during the rooting period require considerable care.

When slash pine cuttings are collected for bench rootings, they are trimmed to a length of about 5 inches. Branches selected for air-layering can be much longer than cuttings. During this study branches which were at least twice, and in some instances three times, as long as cuttings were air-layered (Fig. 7). The greater length helps to give the new propagules a rapid start and up to two years of height growth can be gained.

In selecting branches for air-layering, sturdy, straight shoots should be used if present. Curved branches will retain their form for some time. With this "new" method it should be possible to obtain clones from the refractory forests conifers for experimental outplantings in forest tree improvement programs.

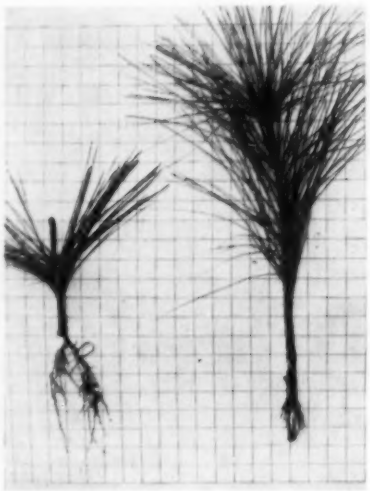

FIG. 7.—Comparison between rooted cutting and air-layered branch. Rooted cutting on left had a total length (above roots) of 6 inches. Air-layered branch was 16 inches long at the time of preparation.

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Loss in Volume of White Pine in New Hampshire Caused by the White-Pine Weevil[1]

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THE white-pine weevil, *Pissodes strobi* (Peck), is the most serious insect pest of eastern white pine. Although rarely, if ever, the direct cause of a tree's death, it can render one partially or completely unmerchantable. Crooked or forked stems resulting from the killing of the leaders for a length generally of two or three whorls and the assumption of dominance by one or more lateral branches are a common sight throughout the range of white pine in the Northeast. Damage is particularly severe in pure plantations and old field stands. The depredations of this insect have materially influenced planting programs, management practices, and utilization of white pine in the northeastern and Lake States.

The total loss in value of pine timber due to the weevil includes losses both in volume and in quality. The loss in volume may be due to decrease in merchantable height and increased taper, or to defects within the merchantable length. The loss in quality may be occasioned primarily by the degrading of sawn lumber and by the utilization of pine for less valuable products. In an economic sense these losses apply only to the trees and stands in the merchantable size classes. However, weevil damage to smaller trees in natural stands and plantations represents a potential financial loss. In the case of plantations the loss is particularly important, yet difficult to appraise, as investments of funds and manpower have been made.

As part of an over-all appraisal of the economic importance of the white-pine weevil in the Northeast, a study has been completed to determine the direct loss in merchantable volume of white pine caused by this insect.

For this study it was desirable to cover a fairly large area where white pine types were fully represented and for which a maximum of basic data, including a complete forest inventory, were available. The State of New Hampshire, where a forest survey was completed in 1948 by the Northeastern Forest Experiment Station (*3*), admirably fitted these specifications.

Procedure

The field data were taken from 102 sample plots established for the forest survey in New Hampshire. These plots, first located in an unbiased manner on aerial photographs, were permanently marked in the field and spotted on topographic maps of the U. S. Geological Survey, with a detailed sketch map of each. All were in pole- and saw-timber stands in white pine (75 percent or more white pine) and white pine—hardwood (50-74 percent white pine) types. The plots were scattered from the Massachusetts state line northward to Littleton, approximately 125 miles, and the number of plots in any given area was in approximate proportion to the occurrence of the two pine types in that area. When this study was made in October and November of 1952, 32 of the plots had been cut over or could not be found, so that substitute plots were taken in adjacent pine stands of similar type and stand condition. All poles (5 to 8.9 inches) were measured on a 1/5-acre plot and saw-timber trees (9 inches and over) on a ½-acre plot, with radii of 52.7 and 83.3 feet, respectively, from the same center. Supplementary observations and measurements of white pine in the larger size classes were made in the vicinity of Amherst, Mass., and at the Yale Forest near Keene, N. H.

The merchantability standards followed were those described in the Forest Survey Field Manual-Northeastern States.[2] Diameter at breast height was measured to the nearest inch. Trees forking below this point were tallied as separate stems, the diameter 3½ feet above the fork being measured or estimated for each. Merchantable height was measured to the nearest 4 feet from a 1-foot stump to a point where utilization was limited by excessive branching, forks, or deformities, or where the estimated diameter inside the bark was 4 inches. Deductions for defects within the merchantable length due to the weevil were made on the saw-log portion of saw-timber trees only, i.e., from the 1-foot stump to a 6-inch d.i.b. top or a point where utilization was limited by large branches. These deductions were recorded as percent of gross board-foot volume of 8-foot sections, and the total cull for a tree was computed from a table for white pine in the Forest Survey Field Manual, which listed the percentage of total board-foot volume in successive 4-foot sections of trees in different merchantable height classes. Volume losses due to causes other than the weevil were not recorded. No cull deductions were made for cubic-foot volume (i.e., on pole-timber trees or that portion of saw-timber trees above the 6-inch and below the 4-inch top) as such volume is not ordinarily decreased by weeviling (sound) defects.

Volume Loss in Pole-Timber Trees

The merchantable volume loss from weevils in pole-size trees is due to loss in merchantable height

[1]Special appreciation is due Royce H. Hutchins, New Hampshire Department of Agriculture, for assistance in the field work. Acknowledgment is also made to the forest survey staff and C. A. Bickford, Northeastern Forest Experiment Station, U. S. Forest Service; Robert P. Holdsworth, Department of Forestry, University of Massachusetts; H. J. Lutz and D. M. Smith, Yale School of Forestry; and J. G. Conklin, state entomologist, New Hampshire.

[2]U. S. Forest Service, Northeastern Forest Experiment Station. Rev. 1950. (Unpublished.)

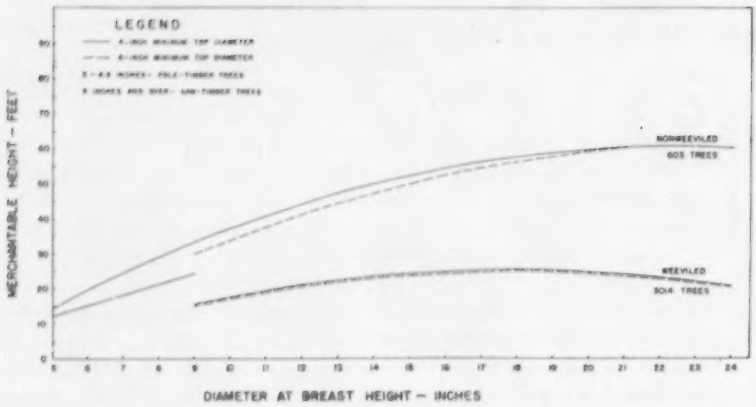

FIG. 1.—Merchantable height of weeviled and nonweeviled white pine in New Hampshire—1952.

TABLE 1.—MERCHANTABLE HEIGHT AND VOLUME OF NONWEEVILED AND WEEVILED POLE-TIMBER WHITE PINE TREES—NEW HAMPSHIRE 1952

	Height to 4-inch diameter top (feet)			Volume (cubic feet)		
D.b.h. (inches)	Nonweeviled trees	Weeviled trees	Height loss in weeviled trees (percent)	Nonweeviled trees	Weeviled trees	Volume loss in weeviled trees (percent)
5	14	12	14	1.50	1.31	13
6	20	15	25	2.68	2.24	16
7	24	18	25	4.18	3.47	17
8	29	21	28	6.05	4.99	18
9[1]	33	24	27	8.26	6.85	17
					Average	17

[1]8.5-8.9 inches.

TABLE 2.—MERCHANTABLE HEIGHT OF NONWEEVILED AND WEEVILED SAW-TIMBER WHITE PINE TREES—NEW HAMPSHIRE 1952

	Height (feet) to minimum top diameter of—				Percent loss in height of weeviled trees
	6 inches		4 inches		
D.b.h. (inches)	Nonweeviled trees	Weeviled trees	Nonweeviled trees	Weeviled trees	
9[1]	30	15	33	15	55
10	34	17	37	17	54
11	38	19	41	19	54
12	41	20	44	21	52
13	44	22	47	22	53
14	47	23	50	23	54
15	50	24	52	24	54
16	52	24	54	25	54
17	54	25	56	25	55
18	56	25	58	25	57
19	58	24	59	25	58
20	59	24	59	25	58
21	60	23	60	24	60
22	60	23	60	23	62
23	60	22	60	22	63
24	60	20	60	21	65

[1]9-9.4 inches.

alone. The relation between merchantable height of nonweeviled and weeviled pole-timber trees is shown in Figure 1, and the average merchantable height for each diameter class, calculated by means of regression,[3] is shown in Table 1. The merchantable volumes of the average nonweeviled and weeviled trees in each diameter class are also given in Table 1.[4] The difference is the average loss in volume of weeviled trees. This loss is shown graphically in Figure 2.

The average merchantable volume loss in weeviled pole-timber trees is shown to be 17 percent. However, of 1,152 pole-timber trees that were sampled 76 percent were weeviled. The average volume loss for all trees in this size class, therefore, was 13 percent.

The forest survey estimated a total net merchantable volume of approximately 3 million cords of white pine in pole-timber trees in New Hampshire in 1948 (*3*). The theoretical volume without loss due to weevil damage, therefore, would be 3.45 million cords. The 13-percent loss attributable to the weevil accounted for 450,000 cords or, on the basis of 78 cubic feet per cord, a loss of over 35 million cubic feet of merchantable volume.

Volume Loss in Saw-Timber Trees

Board-foot volume loss in saw-timber trees results from loss in merchantable height and from deductions within the merchantable height for defects due to the weevil. There is also a loss in cubic-foot, or cordwood, volume from that portion of the stem above the limit of saw-log merchantability.

Saw-log material.—The merchantable height curves of saw-timber trees to both the 4-inch and 6-inch minimum tops are shown in Figure 1.[5] The average heights of nonweeviled and weeviled trees calculated from these curves are given in Table 2, with the height loss computed from the maximum merchantable height (4-inch top) of nonweeviled trees. It is evident that few weeviled trees reach that limit of merchantability. Data for trees over 24 inches are not included, as there were so few the

[3]The regression equations for pole-size nonweeviled and weeviled trees were $Y = 6.927X - 0.156X^2 - 16.437$ and $Y = 3.0X - 3.0$, respectively, where Y = merchantable height in feet and X = diameter at breast height in inches.

[4]Bickford, C. A. Mensuration, tree studies, volume tables, U. S. Forest Service, Northeastern Forest Experiment Station. 1951. (Unpublished.)

[5]The regression equations for the nonweeviled and weeviled saw-timber trees were $Y = 6.927X - 0.156X^2 - 16.437$ and $Y = 4.350X - 0.121X^2 - 13.968$, respectively, where Y = merchantable height in feet to a 4-inch minimum top diameter and X = diameter at breast height in inches.

averages are of doubtful accuracy. The curve for nonweeviled trees is continuous, whereas for those weeviled the curve for pole-timber trees is distinct from that of saw-timber trees (Fig. 1). More loss in merchantable height due to excessive crooks and forks occurs in weeviled saw-timber trees than in pole-size trees. Such defects limit the size of log from which boards can be cut profitably, and it is often uneconomical to even fall badly deformed trees. The merchantability of pole-timber trees, however, is little affected by weeviling defects.

The height loss increases significantly in the diameter classes over 17 inches, owing largely to the increased proportion of completely unmerchantable trees.

The pertinent data on board-foot volume loss for saw-timber trees (*2*) are summarized in Table 3 and are presented for visual appraisal in Figure 3.

The volume loss also increases noticeably in the diameter classes over 17 inches, particularly the loss in board feet. This is a result probably of high-grading practices—selection of the better stands and trees for cutting and disregard for the ill-formed trees returning less profit. Large pines of good form and height were observed infrequently in this study.

Form-class 70 was assumed for both weeviled and nonweeviled trees. Generally, weeviled trees have more taper than nonweeviled trees; so the volumes listed in Table 3 are slightly high for the weeviled and low for the nonweeviled trees. However, the effect of this difference on the total percent loss would be relatively slight.

Of 2,465 saw-timber trees that were sampled, 87 percent were weeviled. As the average board-foot volume loss for the weeviled trees is shown to be 46 percent (Table 3), the average loss for all saw-timber trees, nonweeviled and weeviled, was 40 percent.

The forest survey in New Hampshire revealed an estimated net volume of 3.24 billion board feet in saw-timber trees in 1948 (*3*). The theoretical volume, excluding loss from weevil damage, would be 5.40 billion board feet. The 40-percent loss due to the weevil amounted to 2.16 billion board feet.

The deduction applied by the forest survey for sound cull in white pine of saw-timber size in New Hampshire was 13 percent. The deduction for defects within the merchantable height due to the weevil (sound cull) determined by the present study was 11.6 percent for weeviled trees alone, or 10 percent over all saw-timber trees. This average deduction was consistent

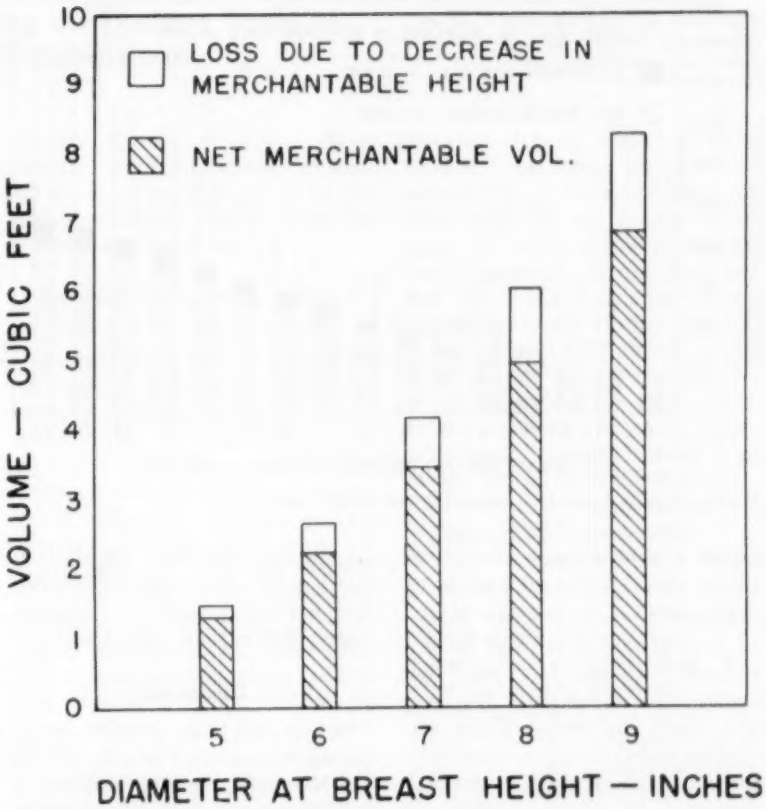

Fig. 2.—Loss in cubic-foot volume of pole—timber trees.

Table 3.—Board-Foot Volume of Nonweeviled and Weeviled Saw-Timber White Pine Trees—New Hampshire 1952

D.b.h. (inches)	Volume (board feet)		Loss in volume of weeviled trees		
	Nonweeviled trees	Weeviled trees	Due to loss in height (b.f.)	Due to weevil culls (b.f.)	Total (percent)
9	30	20	10	2	40
10	43	29	14	3	40
11	56	39	17	5	39
12	74	50	24	6	41
13	97	64	33	7	41
14	116	79	37	9	40
15	141	94	47	11	41
16	166	109	57	13	42
17	196	127	69	15	43
18	224	144	80	17	43
19	254	160	94	19	44
20	291	179	112	21	46
21	327	196	131	23	47
22	365	209	156	24	49
23	405	223	182	26	51
24	442	232	210	27	54
				Average	46

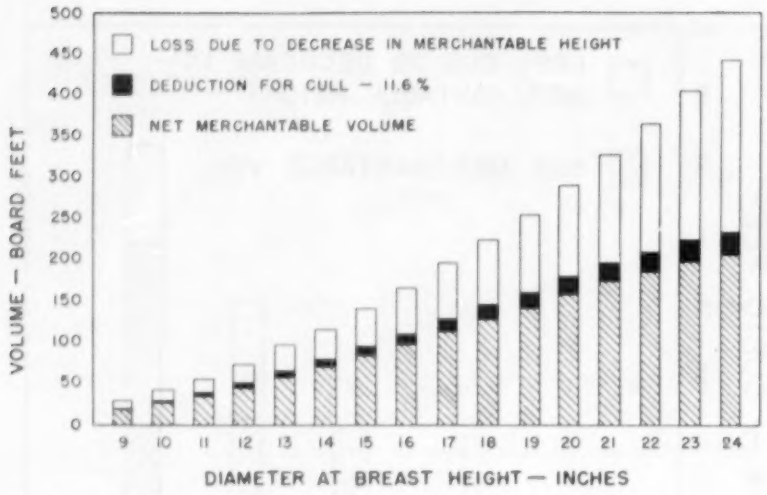

FIG. 3.—Loss in board-foot volume of saw-timber trees.

within a narrow range over all diameter classes (11.6±0.3 percent).

Material other than saw logs.—In trees of saw-timber size there is a further volume loss, small but nonetheless important. The portion above the sawlog limits (excluding limbs) that is merchantable for cordwood or other purposes is decreased by weevil damage. In some nonweeviled trees this section is 20 feet or more in length, and for all nonweeviled trees it averages 2.3 feet. In weeviled trees it is rarely over 8 feet and averages 0.5 foot. This merchantable length in nonweeviled trees decreases directly as the diameter at breast height increases, and in the larger diameter classes it approaches zero as the 6-inch minimum top diameter is seldom attained (Figure 1). Few weeviled saw-timber trees in any diameter class are merchantable even to the 6-inch top.

The difference between 2.3 and 0.5 feet represents a loss of 78 percent in merchantable length and approximately 80 percent in volume for weeviled trees. For all weeviled and nonweeviled trees this is a loss of 70 percent.

In 1948 the forest survey in New Hampshire estimated a total of 637,000 cords in the top portion of white pine saw-timber trees (*3*). There was therefore a potential volume of 2,123,000 cords, as the 70 percent loss due to the weevil amounts to 1,486,000. The theoretical loss in cubic volume (78 cubic feet per cord) would be approximately 116 million cubic feet.

Discussion

White pine is one of the most important commercial tree species in the Northeast. In New England it is by far the most important lumber tree and provides the major supply of raw material for the wooden-box industry and other products as well. The total economic value of white pine to New England alone is estimated to be between $70 and $80 million a year (*1*). Yet its potential productive capacity and economic value are far from realized.

Destructive cutting practices have seriously depleted the reserve of standing white pine in this region. Less evident but equally important, perhaps, is the loss in merchantable volume caused by the white-pine weevil. This loss is intensified, as thousands of acres of plantations of white pine and other hosts of commercial value reach merchantability. Further, the depredations of the weevil extend to other regions, such as the Lake States, where comparable losses may be expected. Damage by this insect is generally accepted as an unavoidable devilment of nature—which in a sense it is. As the present commodity drain on white pine exceeds its growth—by more than 35 percent in saw-timber trees in New Hampshire—conservation and protection of the timber crop must be made a part of white pine management, if the lumber and allied industries are to depend on it as a continuing source of supply. More positive action might have been taken with regard to the weevil, for example, if reliable data on the losses due to this pest had been available. The present study and report is the result of a cooperative effort for that purpose.

Summary

A study was conducted in New Hampshire during October and November 1952 to determine the loss in merchantable volume of white pine attributable to the white-pine weevil, *Pissodes strobi* (Peck), for the productive capacity of the pine timber crop has been seriously reduced.

The average volume loss by diameter class of trees up to 24 inches d.b.h. was 13-percent in pole-size trees (5 to 8.9 inches d.b.h.), and 40-percent in the saw-log portion (board-foot volume) of saw-timber trees (9 inches d.b.h. and over) and 70-percent in the portion above saw-log limits of merchantability (cubic volume). These losses represent 450,000 cords, or 35 million cubic feet, of potential merchantable volume in pole-timber trees, 2.16 billion board feet in the saw-log portion of saw-timber trees, and 1,486,000 cords, or 116 million cubic feet, for material other than saw logs. These volume losses are computed from net merchantable volumes determined by a forest inventory of New Hampshire in 1948 by the U. S. Forest Service.

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Some Effects of Burning on Forest Soils of Western Oregon and Washington

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THE OBJECTIVE of modern industrial forestry for maximum sustained yield production from timberlands, is dependent upon (1) prompt and adequate restocking following clearcutting, and (2) maintaining the highest possible growth rate in new timber stands. Ability to cut to maximum sustained yield capacity requires prompt restocking of cut-over lands, since the rate of cutting is determined today by future rate of volume replacement by young stands. Properties of forest soils in which trees are grown affect significantly the degree to which these objectives can be realized. It is important that the properties of forest soils, as they affect establishment and growth of new stands, are known, as well as changes in these properties brought about by various kinds of land management operations. Fire is one of the most significant of these factors.

Crown Zellerbach's program of forest soils research began in the summer of 1948. One of the first major studies undertaken was the effects of fire on particular soil types found on the company's timberlands, and interpretation of the soil changes caused by fire in terms of establishment and growth of reproduction stands. This represents only one aspect of the many unanswered questions on Pacific Northwest forest soils. Some of the conclusions are necessarily tentative. This paper is a progress report using the case-history method of presentation.

Studies Initiated

Two studies were made of the effect of burning on forest soil. (1) Examination in the field and laboratory of soil samples from selected burned and unburned control plots immediately after the burns, and periodically thereafter. (2) Study of the soils of specific problem areas where poor reproduction, growth, health, or survival have been outstanding enough to justify special attention. Slash burning or the fire history on some of these areas appears to be the principal factor causing degraded condition or performance.

Selected Burn Areas Project

Plot Location and Description

Clatsop plots—An accidental fire in logging slash on the westward slope of the coast range in Clatsop County, Ore., provided the first test plot location. Plot A was selected to represent "hard burned" conditions, where all organic surface matter was consumed and the exposed mineral soil was colored brick red. Plot B was selected to represent "moderately burned" conditions, where the forest litter and a large portion of the humus was consumed, but where the exposed mineral soil was not reddened. An unburned area nearby provided a control plot for both burned plots. The soil is a mellow, almost a silt loam and has an effective rooting depth around 44 inches. The underlying bedrock is fractured basalt. Many large bedrock boulders are scattered about on the surface. Elevation is 1,760 feet; annual rainfall 90-100 inches. The original forest was the Sitka spruce-western hemlock mixture common in the wet belt along the coast.

Clackamas plots—These are all located on the west slope of the Cascades in Clackamas County, Ore. Plot A was established at a landing cleanup burn where "hard burned" conditions prevailed and mineral soil had been red-burned in patches over much of the surface. An adjacent unburned control plot was also established. Average annual rainfall is about 50 inches; elevation is 2,300 feet. The loam to clay loam soil is 40 to 48 inches deep over hard igneous (andesitic) bedrock. It is somewhat gravelly. About 25 percent of the soil volume is taken up by large fragments of bedrock.

Plot B was set up in a controlled slashing cleanup fire. "Moderate burned" conditions prevailed where little of the surface soil had been reddened but nearly all the litter and much of the humus had been consumed. An unburned control plot was also laid out as near as possible to the burned plot. The soil is a gravelly, almost a clay loam and is 30 to 36 inches deep over hard andesitic bedrock. Twenty to 25 percent of the soil volume is occupied by large bedrock fragments. Elevation is 2,800 feet; annual rainfall averages 50-60 inches.

Plots C and D were located in an extensive logging-slash cleanup burn. The intensity of burning was in the "moderate" range where comparatively little of the mineral soil was discolored red. Most of the litter and humus were removed. A nearby unburned area served as a control plot for both burned plots C and D. The notable difference between these two plots is that plot C has about 25 percent slope while D has about 60 percent. The soil is a loam approaching a clay loam with 44 to 48 inches effective rooting depth. This graduates downward to a layer, one or more feet thick, of partly decomposed bedrock fragments mixed with heavy clay soil lying immediately over the igneous bedrock. Elevation is 1,800 feet; annual rainfall averages about 50 inches. The original forest in the Clackamas area was mostly Douglas-fir with western hemlock and Noble fir increasing with elevation.

Procedure

In each case the procedure was to take representative soil samples from (1) the surface ½ inch after removal of limbs, twigs, and other refuse not an integral part of the soil; (2) the layer down to a 2-inch depth; (3) the zone between 6- and 12-inch depths; and (4) the subsoil at about the depth of maximum root penetration. All plots were sampled initially as soon as possible after the slash burn in late October and early November 1949.

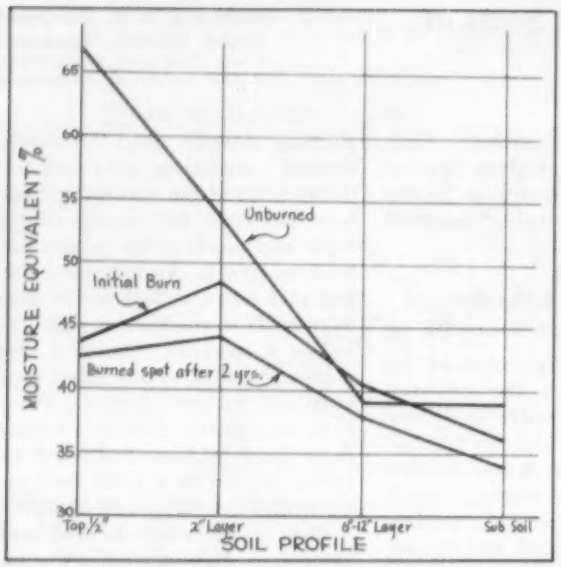

FIG. 1.—Moisture equivalent averages in percent found in studies of burned soils.

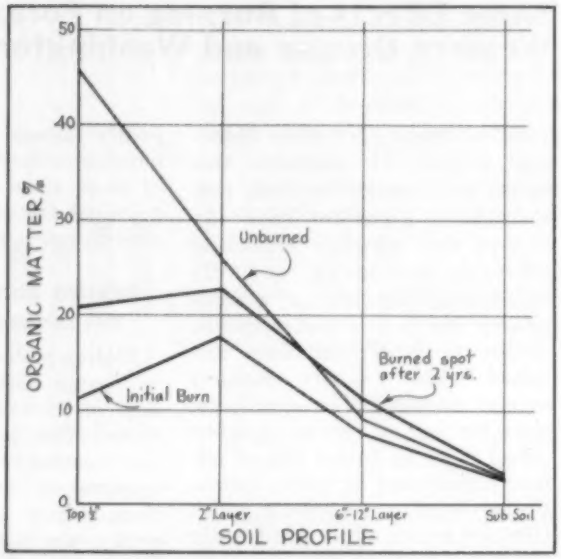

FIG. 2.—Organic matter averages in percent found in studies of burned soils.

The samples of soil taken in September 1951, after the 2-year time lapse, were adjacent to the original spots.

The results of similar tests on all plots have been averaged for clarification. These averages are further simplified by arrangement in chart form so that general trends may be visualized more easily. It must not be assumed that these average test values represent any one specific soil because values from two or more soil types have been assembled. The effects of fire, however, were quite similar on the various soils included in this study. These values are intended to show more simply the general effects and the amount of disturbance from the normal that might reasonably be expected whenever forest soil is subjected to moderate or severe burning.

Discussion of Results

Moisture equivalent tests measure the ability of the soil to retain moisture after centrifuging for 30 minutes at 1,000 times the force of gravity. The results of this standard closely approximate the moisture holding performance of soil in the field. Figure 1 shows how burning of logging slash has reduced the average moisture holding ability of the top ½ inch or so of soil by 33.7 percent. This effect has persisted for two years in these study plots. As moisture is a primary need of any growing plant, a reduction of this magnitude can easily be the difference between s u r v i v a l or death of tree seedlings, particularly in border-line cases such as gravelly or shallow soils, or exposed south slopes.

Total organic matter average results (Fig. 2) were obtained by the standard method of oxidation with sulfuric and chromic acids. Burning the slash has reduced this material in the surface ½ inch from 46.3 percent to 11.3 percent—a drop of 75.5 percent based on the original content. The beneficial action of organic matter on soil has been highlighted recently by the advent of chemical soil conditioners such as "Krilium." Some of these beneficial actions are:

1. Improves soil structure by aggregation of soil particles.
2. Improves drainage and aeration.
3. Increases water-holding capacity.
4. Retards moisture loss through evaporation.
5. Inhibits compaction and crusting.
6. Holds erosion to a minimum.
7. Acts as a storehouse for nutrients.

Unquestionably the removal of organic matter is a major loss to the site and this one effect of burning forest refuse probably has more significance than the others combined. Recovery is slow. A lapse of two years after burning shows the burned areas to have 50 percent as much organic matter as the unburned control spots. Results of all other tests made in this study—moisture equivalent, total nitrogen, pH, nutrient elements—are strongly influenced by the presence or absence of organic matter. A deep soil, rich in organic components, can probably withstand a moderate fire and recover well enough to escape serious damage. A shallow or gravelly soil or a steep south slope cannot.

Total nitrogen tests were made by the standard Kjeldahl method. Averages of the results from the six plots are shown in Figure 3. These averages show a reduction of 67 percent in this critical nutrient element (from 0.79 to 0.26). After a lapse of two years the surface soil had returned to 0.48 percent, which is almost double that at the original burn, but only 75 percent of the unburned control average. The extreme low in total nitrogen after burning was found at the hard burned spot on the Clatsop Tree Farm. Here the top ½ inch of soil

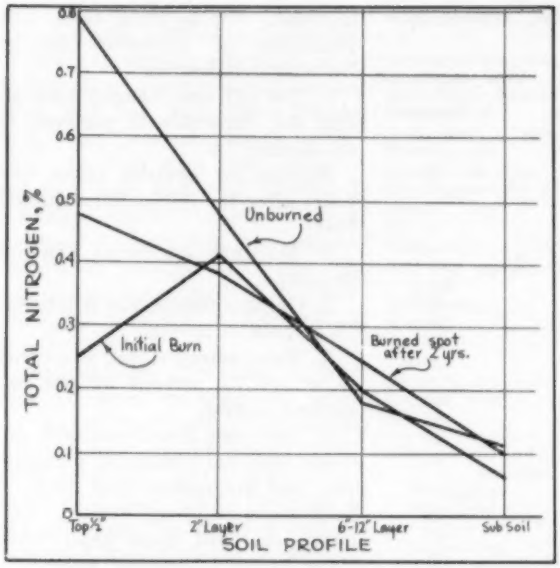

Fig. 3.—Total nitrogen averages in percent found in studies of burned soils.

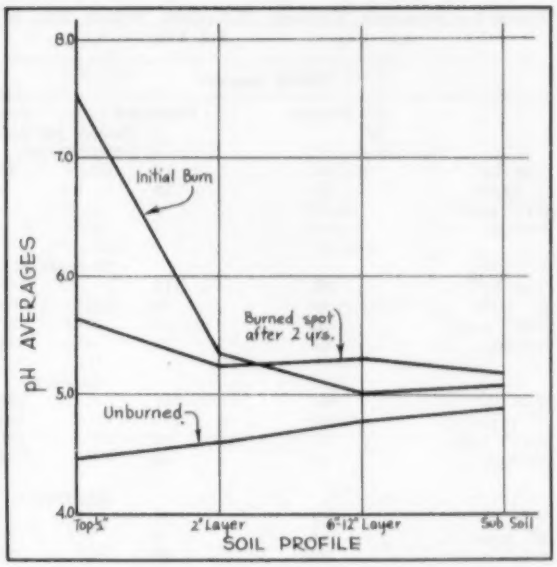

Fig. 4.—Average pH values found in burned soils.

had only 0.04 percent nitrogen immediately after burning. Recovery was about normal, however.

The burning of logging slash releases phosphorus, potassium, calcium, and magnesium—the major nutrient elements—in varying amounts into the soil in soluble or available form. The source of these minerals is the ash from the forest litter of logs, limbs, twigs, leaves, and other organic material consumed in burning. The test method used for these nutrients was devised by Spurway and Lawton at Michigan State College. The amount of available phosphorus was more than twice as high on the burned as on the unburned plots but returned to about normal before the end of two years (Table 1). Potassium was 166 percent higher, but returned to 112 percent by the end of two years. The amount of calcium released was much greater than the other nutrients, reaching 830 percent of the normal unburned soil immediately after the fire. Two years later this element was still 327 percent of that on the control area. The average tests for magnesium show that the amount available in the burned soil was 337 percent of that in the unburned control. By the end of two years this had dropped to normal. The above nutrient test values are the results from the top ½ inch of soil. The effect diminishes considerably by the time the 2-inch depth is reached, but is still noticeable.

This sudden increase of fertility elements in the soil greatly disturbs the balance or ratio between them. This ratio is important, as an unbalanced condition in nutrients can be responsible for poor health and growth of seedlings as stated by Dr. S. A. Wilde.[1] He writes: "In nursery management the state of soil fertility is one of the most important factors that affect the development of seedlings. A deficiency of any of the essential nutrients or an unbalanced ratio has a far-reaching influence on the entire process of metabolism. The ill effects of malnutrition are reflected in abnormal size and color of leaves, inadequate root systems, unbalanced top-root ratio, thin cell walls and porous structure of wood tissue, underdeveloped nuclei in the perenchymatic cells, and other anatomical and physiological abnormalities. Ultimately, all of these ailments result in a decreased resistance of seedlings to drought, frost, and infectious diseases."

[1]Wilde, S. A. Soil-fertility standards for growing northern conifers in finest nurseries. Jour. Agricultural Research 57: (12) 945. 1938.

The pH measurements in this work were made with a glass electrode pH meter. The top ½ inch of the soil became quite alkaline (average pH 7.6) after a slash burn, compared to 4.5 at the unburned control spots. After two years the test had dropped down to 5.7 in the burned spot as against 4.7 unburned (Fig. 4). The highest pH measured after burning was 8.9 in the surface soil of Plot A, Clackamas Tree Farm. Two years later the pH at this spot was 5.9.

Mechanical analysis tests, giving the percentages of sand, silt, and clay in the soil, show that burning of the forest slash and refuse had no significant effect on the quantities of these primary soil particles present.

Results and Conclusions

The measurable physical and chemical effects on the forest soil of burning logging slash are confined to the top two inches of soil depth and usually are concentrated in the ½- to 1-inch depth zone. Two years after burning, the soil in the study plots had only partly readjusted to normal.

In the top ½ inch or so significantly affected by the fire, the average results of all tests made on soil samples taken from the study plots

TABLE 1.—AVAILABLE NUTRIENT ELEMENTS, BURNED SOIL STUDIES. AVERAGE FROM SIX PLOTS[1]

	Initial samples		Two years later	
	Burned	*Unburned*	*Burned*	*Unburned*
		Pounds per acre		
		PHOSPHORUS		
Top ½"	37	17	19	10
2" layer	14	19	8	7
6-12" layer	7	4	4	4
Subsoil	4	2	2	2
		POTASSIUM		
Top ½"	184	111	127	113
2" layer	98	54	64	77
6-12" layer	45	30	39	80
Subsoil	27	20	11	51
		CALCIUM		
Top ½"	887	107	350	107
2" layer	160	100	160	93
6-12" layer	67	93	100	93
Subsoil	40	40	70	93
		MAGNESIUM		
Top ½"	81	24	15	13
2" layer	48	6	12	13
6-12" layer	33	19	14	14
Subsoil	20	7	14	13

[1]Values show amounts which would be present in a 6-inch-deep layer of soil, one acre in area, of the same composition as the sample.

TABLE 2.—SOIL AND SITE CHARACTERISTICS—NOBLE FIR PLANTATIONS. CLACKAMAS TREE FARM

	Good growth area	*Poor growth area*
Elevation	2,400 ft.	2,500 ft.
Ave. temp. Apr. to Sept.	50-55 deg. F.	50-55 deg. F.
Ave. rainfall	50 inches	50 inches
Timber type	Douglas-fir-true fir	Douglas-fir-true fir
Position on slope	Middle	Upper
Percent slope	20	25
Aspect	SW	SW
Soil	Clay loam	Clay loam
Texture	Medium	Medium
Stoniness, percent	Less than 20	20 to 40
Bedrock	Igneous, Andesitic	Igneous, Andesitic
Effective rooting depth, inches	40	28
Logged	1942	1943
Burned	1943	1944
Planted	1946	1948
Moisture equivalent	32.8	30.9
Organic matter, percent	13.5	13.0
pH	5.3	5.3
Nutrient elements, pounds per acre		
Phosphorus	4.0	2.4
Potassium	16	16
Calcium	120	240
Magnesium	8	8
Mechanical analysis, percent		
Sand	27.8[1]	24.8[1]
Silt	37.2[1]	44.2[1]
Clay	35.0[1]	31.0[1]
Gravel[2]	43.5	64.5

[1]Gravel-free soil.
[2]Percent. The material passing the ¼ mesh sieve and retained on the 2 mm sieve.

showed that immediately after a burn:

1. The water holding ability (moisture equivalent) was reduced 33.7 percent.

2. A 75.5 percent loss of organic matter occurred.

3. Sixty-seven percent of the total nitrogen, a critical nutrient element, was lost.

4. The available (easily soluble) quantities of the major nutrient elements phosphorus, potassium, calcium, and magnesium had been increased two to eight fold. The possibility of excessive loss by leaching is indicated.

5. The pH was changed from an acid 4.5, favorable to conifers, to an alkaline 7.6.

Results on samples taken two years after the initial burn showed that:

1. Moisture equivalent had not improved.

2. Organic matter was still below 50 percent of normal.

3. Total nitrogen had recovered to about 75 percent of the unburned control.

4. The quantities of available nutrient elements potassium, phosphorus, and magnesium had dropped back down to about normal. Calcium was still more than three times unburned control value.

5. The pH was reduced to a more favorable 5.7 but is still above the average unburned value.

Germination and early survival of conifers is undoubtedly severely influenced by nutrient imbalances and losses. Moisture relationship disturbances, as indicated by moisture equivalent and organic matter tests, are a much more critical result of the burning of logging slash and forest refuse. This is true particularly in conjunction with extremes of temperature brought about by exposure of the soil surface to elements of weather. It is emphasized when the soil originally has a low moisture supplying ability such as a shallow or gravelly condition, or when steep south slopes are encountered.

Case Histories of Some Problem Areas

Slash or forest refuse burning does, in many instances, degrade forest soil so that regrowth is unsatisfactory as shown by the following examples of problem areas on some of the Crown Zellerbach Corporation tree farms.

Poor Growth of Trees in a Noble Fir Plantation

On the Clackamas Tree Farm, lying on the western slopes of the Cascades in Clackamas County, Ore., there is a plantation of Noble fir where the trees, compared to a nearby planting of the same spe-

cies, are growing poorly. Trees in the poor area, planted in the spring of 1948, apparently were just able to stay alive. Four growing seasons later they had little more foliage than when planted. Those in the better location were from three to six feet high and well developed laterally. Slash fires in both areas previous to planting, had almost completely removed all logging refuse, forest litter, and duff. Only blackened stumps and a few charred logs remained.

Comparisons of results of field and laboratory examinations made on the soil from both areas (Table 2) show that organic matter, moisture equivalent, nutrient elements, and pH tests are nearly identical in the two spots. In contrast, tests of potential drouthiness — effective soil depth, percent of gravel in the topsoil, and position on slope—indicate that moisture available for tree growth is significantly less at the poor growth plantation. Although this area is not expected to produce trees as well as the good plantation, it did produce timber satisfactorily in the past. Some occurrence since the original forest was removed has prevented it from producing again. The only identifiable occurrence of this nature has been slash burning. Undoubtedly fire removed as much humus, limbs, logs, and twigs from the good growth area as the poorer one but because of the deeper, less gravelly soil and better slope location its ability to grow trees has not been measurably degraded. The removal of the same amount of organic forest floor refuse from the less favorable site, however, almost cancelled its ability to produce. The drought hazard of this poorer plantation has been so much increased by loss of moisture holding advantages of an organic blanket, that it has become unable to support proper tree growth. Here is a good illustration of how uncontrolled fire can seriously reduce the productivity of an unfavorable site.

Table 3.—Soil and Site Characteristics—Neah Bay

	Good growth	*Poor growth*
Elevation, feet	600-1000	600-1000
Ave. temp. Apr. to Sept., degrees F	50	50
Ave. rainfall, inches	82	82
Timber type	Spruce-Hemlock	Spruce-Hemlock
Position on slope	Middle	Middle
Slope, percent	20	20
Aspect	West	West
Soil	Loam	Loam
Texture	Medium	Medium
Effective rooting depth, inches	34	34
Substratum	Compact till	Compact till
Logged	1935	1935
Burned	1937	1937
Planted	1944	1944
Moisture equipment	47.4	50.8
Organic matter, percent	16.2	22.1
pH	5.23	4.65
Nutrient elements, pounds per acre		
Phosphorus	4.3	2.8
Potassium	11	0
Calcium	160	0
Magnesium	16	8
Nitrogen (active)	2.7	0
Mechanical analysis, percents		
Sand	43.	43.3
Silt	42.3	40.8
Clay	14.5	15.9

Table 4.—Soil and Site Characteristics, Youngs River Spruce Plantations—Clatsop Tree Farm

	Good growth	*Poor growth*
Elevation, feet	800	800
Ave. temp. Apr. to Sept., F.	57	57
Ave. rainfall, inches	70	70
Timber type	Spruce-hemlock	Spruce-hemlock
Position on slope	Middle	Middle
Slope, percent	10	5
Aspect	Southerly	Northwest
Soil	Silt loam	Silt loam
Texture	Medium	Medium
Substratum	Dense clay	Dense clay
Effective rooting depth, in.	30-36	20-26
Competitive vegetation	Very little	Heavy bracken
General appearance of spruce	Good color and development	Poorly developed, fair color
Logged	1926	1926
Burned	1928	1929 and 1932
Planted	1930	1930 and 1933
Moisture equivalent	47.2	52.8
Organic matter, percent	9.8	15.5
pH	4.6	4.6
Total nitrogen, percent	0.33	0.40
Nutrient elements, pounds acre		
Phosphorus	12	2.4
Potassium	0	0
Calcium	160	0
Magnesium	16	8
Nitrogen (active)	48	0
Mechanical analysis, percent		
Sand	19.5	20.5
Silt	57.8	55.8
Clay	22.7	23.7

Neah Bay Poor Health and Survival Spots

A 1944 plantation of Sitka spruce and Port-Orford-cedar on the Neah Bay Tree Farm, Clallam County, Wash., the northwest tip of the U. S., has developed patches where there is poor survival of planted trees. Poor health of surviving trees and native vegetation is also evident in these spots. To find the cause of these variations a field cruise included intense examination of four of these poor spots, in conjunction with three adjacent good growth areas. Soil samples were taken from both areas and

examined in the laboratory.

Field observations did not reveal any general physical soil conditions responsible for poor growth. Soil depth is adequate, ranging around 30 to 40 inches in both the good and poor spots. Texture is medium and uniform. The substratum is a densely compacted glacial till, characteristic of this soil type. The presence of as many and as large stumps from the original forest in the poor zones as in the good points definitely to some recent activity as being responsible for the degraded condition.

Results of laboratory tests on soil samples taken from both type areas indicate diffrences that are probably responsible for the observed growth and health variations. The level of the alkaline nutrient elements, particularly calcium (Table 3) in the soil from the poor spots shows the low fertility conditions existing here. These same poor spots have a pH from 0.2 to 0.9 lower than the good areas and this again brings out the lack of alkaline elements—calcium, potassium, and magnesium in the soil. Results of the laboratory tests for moisture equivalent, organic matter, mechanical analysis, and total nitrogen do not reveal significant variations (Table 3).

Localized exceedingly hot fires in the original burn or later readily account for the barren patches where there is now poor health and growth. The rapid release, by a hot fire, of all the nutrients stored in the organic matter on the forest floor will leave little for gradual release by decay.

Youngs River Spruce Plantations on the Clatsop Tree Farm

In Clatsop County, Ore., two Sitka spruce plantations are showing extreme contrast in growth and health.

The trees in the good growth area were planted in 1930 after the area had been logged (1926) and burned (1928). The trees are tall, well formed, and have almost completely taken over the site. Those on the poor growth plantation were planted in 1933 after the area had been burned twice (1929 and 1932) following logging in 1926. These trees are stunted and scrubby and dense bracken fern, eight feet and more high, is giving much competition. Elevation in both cases is near 800 feet; rainfall around 90 to 100 inches. Field soil examinations in the plantations did not reveal significant differences, and laboratory examinations yielded the only outstanding variation that was found between the soils of these areas. Available nutrients were on the low side in the poor growth soil (Table 4).

The conclusion was that repeated burning with the accompanying leaching occurring in this high rainfall area depleted the nutrients to such a low level that the conifers were unable to compete successfully for these nutrients with weeds, fern, and brush.

Some of the effects of fire on the physical and chemical properties of these forest soils, and some results of these changes in terms of forest production have been given in this article. Many other effects of fire have not been covered such as erosion, changes in normal floral succession, and effects on the microflora and fauna. Fire can be an enemy or a tool of management. In some cases, it may be a necessary evil. Only by knowing its results can proper evaluation be given to its danger or value in the long-term objectives of forest management.

Worth Repeating

". . . the whole forest"

No matter for what particular purpose a forest is to be managed, for timber production, for the protection of the soil, for the control of waters, for the maintenance of aesthetic, scientific or recreational values, or for multiple use, success in management is contingent upon possession of a thorough understanding of the whole forest. Management, to be successful, must be founded in a deep appreciation of the forest, of its origins and structure and of the complex interrelationships of all its component parts. And, since a forest is an ever-changing, living community, management also demands unremitting study of all trends in forest evolution, man-made or natural. For any single forest the complex actions and interactions of plants, soils, animals, micro-organisms and men, together with all factors of climate, topography, lithology and history, must be studied separately and in synthesis.

The prosecution of such studies is no simple or short term task; and a full understanding is unlikely to be gained by any individual student however competent. In this field of endeavour it is almost impossible to isolate a single, sharply defined problem from the tangled mass of inter-related problems producing, by diligent research, a polished memoir unassailable in fact and in logic. We must be satisfied if, aiming at the stars of final truth and complete comprehension, we can present what appears to be one aspect of the truth for consideration and evaluation by our critics and fellow students.—JOHN T. HOLLOWAY in "Forests and Climate in the South Island of New Zealand" Roy. Soc. New Zealand Trans. 82 (2): 329-410, illus., 1954.

Effects of Flooding on Woody Plants, West Sandy Dewatering Project, Kentucky Reservoir

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THE WEST SANDY project is one of eight malaria control dewatering projects in the design and construction of Kentucky Reservoir on the Tennessee River (*1, 2*). The major objective of these projects, which were not cleared of natural vegetative cover, was to minimize anophelism by pumping the water from behind diked areas during the anopheline breeding season.

Experience since impoundment of the reservoir in September 1944 has shown that summertime dewatering is feasible in some areas but not in others, depending on size of watershed, amount of inflow, and local stratigraphy (*3*). The West Sandy project is one area which proved difficult to maintain in a dewatered condition. Significant flooding has occurred during the anopheline breeding season in wet years. Thus, from a functional aspect, it has operated more or less as an uncleared, or partially cleared, flood control reservoir with fixed maximum discharge. During periods of high streamflow it has not been completely effective as a dewatering project to control anophelism.

This report covers a portion of studies made of the project to improve its operating economy and effectiveness, including a general description of the project, experiences with water schedules, and emphasizing the general effect of flooding on woody plants.

General Description of the Project Area

The West Sandy diking and dewatering project is located in Henry County near Springville, Tenn. The earth fill dike is on West Sandy Creek approximately four miles upstream from the confluence of this creek with Big Sandy River, a tributary of the Tennessee. The dike is 3,590 feet in length and approximately 20 feet high. It is 10 feet wide at the crest, with an outboard slope of 8:1, an inboard slope of 3:1. At the south end of the dike is a two-story concrete pumphouse, at the north end an earth spillway 3,170 feet long and 650 feet wide. The pumphouse contains six electrically driven pumps with a combined capacity of 250,000 gallons per minute.

The area scheduled for dewatering during the anopheline breeding season involves 3,343 acres at top summer pool level for Kentucky Reservoir, or elevation 359 feet (Table 1). In 1944 practically this entire area was densely covered by average bottomland forests. Storage in the diked area at elevation 359 feet approximates 12,700 acre-feet. With the installed pump capacity it can be dewatered at a gross rate of 1,100 acre-feet per day. The storage basin has some 38 miles of shoreline at elevation 359 feet, an area of approximately five square miles, and serves a watershed of some 144 square miles.

TABLE 1.—ACRES BETWEEN VARIOUS CONTOURS—WEST SANDY DEWATERING PROJECT

Intervals in feet below top summer pool level (359 ft.)	Acres	Percent of total acres
0 to 2 ft.	505	15.1
2 to 5 ft.	801	24.0
5 to 9 ft.	1,157	34.6
9 to 16 ft.	880	26.3
Total	3,343	100.0

Water Level Schedules

The annual water schedule proposed for the West Sandy project consisted of the following four phases: (1) wintertime operation with Kentucky Reservoir, (2) a sharp springtime drawdown, (3) maintenance of the dewatered condition during the anopheline breeding season, and (4) refilling during the wet, winter season. This type of schedule was projected to bypass anophelism and to protect the bottomland forests as much as possible from the adverse effects of flooding during the growing season. Trees provide protection against erosion for a highway fill across the lower part of the area and for the dike during periods of high water levels.

The area was dewatered accord-

TABLE 2.—TOTAL NUMBER OF DAYS VARIOUS CONTOURS FLOODED DURING GROWING SEASONS FROM SEPTEMBER 1, 1944 TO JULY 1, 1952, WEST SANDY PROJECT
(Period April 1—October 1 used for the growing season, and maximum possible flooding during growing seasons equal 1,402 days.)

Contour	April	May	June	July	Aug.	Sept.	Total	Percent of time flooded
361	0	0	0	0	0	0	0	0.0
360	3	0	0	0	0	0	3	0.2
359	10	0	0	1	0	0	11	0.8
358	29	7	0	14	0	3	53	3.8
357	89	20	2	17	0	6	134	9.6
356	146	28	11	20	0	17	222	15.8
355	176	49	15	23	0	29	292	16.3
354	191	66	23	25	0	30	335	23.9
353	197	83	32	26	1	30	369	26.3
352	209	94	39	28	1	37	408	29.1
351	216	105	46	33	5	40	445	31.7
350	221	116	52	38	13	43	483	34.5
349	223	130	57	40	19	49	518	36.9
348	224	150	65	49	26	56	570	40.7
347	229	162	77	60	41	64	633	45.1
346	233	189	118	74	60	81	755	53.9
345	234	226	166	127	106	127	986	70.3
344	240	245	203	153	141	167	1149	82.0
343	240	248	240	217	217	229	1391	99.2

[1]The authors are with the Malaria Control Branch, Division of Health and Safety, TVA.

TABLE 3.—EFFECT OF FLOODING ON PLANTS—WEST SANDY DEWATERING PROJECT (Plants listed in order of increasing tolerance to flooding as indicated by the lowest healthy tree observed during the summer of 1952.)

Species[1]	Healthy line Lowest healthy tree Elev.	Healthy line Lowest healthy tree Percent of time flooded during all growing seasons	Dead line Lowest sickly tree Elev.	Dead line Lowest sickly tree Percent of time flooded during all growing seasons
Black cherry (*Prunus serotina*)	359.4	0.6	356.4	13.4
Flowering dogwood (*Cornus florida*)	359.0	0.8	356.7	11.6
Hornbeam (*Ostrya virginiana*)	358.7	1.8	356.7	11.6
Sassafras (*Sassafras albidum*)	358.5	2.3	357.7	5.6
Beech (*Fagus grandifolia*)	358.2	3.2	355.5	16.1
Yellow-poplar (*Liriodendron tulipifera*)	357.9	4.5	355.5	16.1
Christmas holly (*Ilex opaca*)	357.0	9.7	354.9	17.0
Pawpaw (*Asimina triloba*)	356.7	11.6	356.7	11.6
Redcedar (*Juniperus virginiana*)	356.3	14.0	353.8	24.4
Black alder (*Alnus rugosa*)	355.9	15.8	353.7	24.6
Shagbark hickories (*Carya* spp.)	355.7	16.0	354.2	22.4
Loblolly pine (*Pinus taeda*)	355.4	16.1	355.4	16.1
Blackgum (*Nyssa sylvatica*)	355.0	16.3	353.4	25.3
Water oak (*Quercus nigra*)	355.0	16.3	354.0	23.9
Catalpa (*Catalpa* sp.)	354.7	18.6	354.0	23.9
Pignut hickories (*Carya* spp.)	354.6	19.4	354.5	20.2
Ironwood (*Carpinus caroliniana*)	354.1	23.2	353.1	26.1
Birch (*Betula nigra*)	354.1	23.2	350.0	34.5
Sycamore (*Platanus occidentalis*)	354.0	23.9	351.2	31.2
Winged elm (*Ulmus alata*)	353.7	24.6	353.6	24.9
American elm (*Ulmus americana*)	353.7	24.6	348.5	38.8
Hackberry (*Celtis* sp.)	353.6	24.9	353.6	24.9
Swamp blackgum (*Nyssa sylvatica* var. *biflora*)	353.1	26.1	353.1	26.1
Cow oak (*Quercus michauxii*)	352.2	28.6	350.2	34.0
Honeylocust (*Gleditsia triacanthos*)	352.0	29.1	349.8	35.0
Persimmon (*Diospyros virginiana*)	351.5	30.4	349.3	36.2
Willow oak (*Quercus phellos*)	351.4	30.6	347.8	41.6
Hawthorn (*Crataegus* sp.)	351.0	31.7	349.0	36.9
Sweetgum (*Liquidambar styraciflua*)	350.1	34.3	347.4	43.3
Cottonwood (*Populus deltoides*)	350.0	34.5	350.0	34.5
Deciduous holly (*Ilex decidua*)	349.7	35.2	349.0	36.9
Red maple (*Acer rubrum* var. *drummondii*)	349.2	36.4	348.0	40.7
Water tupelo (*Nyssa aquatica*)	348.6	38.4	346.1	53.0
Ash (*Fraxinus* sp.)	348.6	38.4	347.8	41.6
Pin oak (*Quercus palustris*)	348.4	39.2	348.1	40.3
Buttonball (*Cephalanthus occidentalis*)	348.4	39.2	346.1	53.0
Overcup oak (*Quercus lyrata*)	348.1	40.3	346.3	51.2
Black willow (*Salix nigra*)	347.6	42.5	345.7	58.8
Swamp ironwood (*Planera aquatica*)	347.5	42.9	346.0	53.9

[1]Scientific names follow U. S. Dept. Agric. Check list of native and naturalized trees of the United States, Agric. Hdbk. 41, 1953.

ing to schedule in only three of the first seven seasons it was in operation. During periods of high inflow, dewatering was not practicable even though the pumps operated at full capacity. In this respect, runoff from the West Sandy watershed is extremely important. The area of the watershed is about 30 times that of the storage basin. Deviations in water levels from the planned operations schedule were of sufficient magnitude and duration to favor anophelism periodically and to adversely affect the forests within the basin.

Continuous hydrographs of water levels behind West Sandy dike have been recorded since March 1945. Elevations prior to that time were interpolated from daily gauge readings at Kentucky Dam and at Johnsonville, downstream and upstream from the diked-off area. It was possible from these records to determine the total number of days the various contours were flooded throughout the life of the project.

April 1 to October 1 was designated as the plant growing season, October 1 to April 1 as the dormant season. These dates were assumed on the basis of a general knowledge of the phenology of plants in the area. Murray, Ky., some 20 miles north of West Sandy, has a growing season of 187 days, the average last spring freeze being April 15 and the average first fall freeze being October 19. The maximum number of days of flooding possible during the period September 1, 1944, to July 1, 1952, was 1,402 for the growing seasons, and 1,458 for the dormant periods (Table 2).

Method of Sampling and Effect of Flooding on Forests

Before any sampling was done to determine the effects of inundation on the common trees and shrubs, reconnaissance was made to observe the overall survival pattern of the different species and to see if there was any evidence of vertical stratification in species survival. These observations did show definite vertical stratification in survival among a number of species, related apparently to contour distribution of amount of flooding. As one progressed upstream by helicopter, survival contours were strikingly apparent. In the zone flooded for the longest period of time, all woody species were dead. The zone only rarely flooded showed few

dead species (i.e., beech, poplar, etc.). The zone between these two showed an intermediate number of species affected adversely.

Because of variations in topography and species, a detailed ground study was necessary. Sampling was done by transecting the area at various locations and taking elevation readings from the bases of selected trees. Two main elevations were established for each species—the "healthy line" and the "dead line." An effort was made to establish ten elevation readings for each species along these two lines, but for some species this was not always practical.

The dying, sickly, and healthy trees were carefully sought out over a wide area by sampling different areas or tributary arms of the basin. The healthy line was established by taking elevation measurements from the bases of healthy trees to those that were dying. The dead line was established by taking readings on the lowest sickly specimens that could be found among the dead trees and those affected beyond the point of recovery. The readings were taken on actual specimens where they were found. Therefore the healthy line for each species was represented by the lowest single individual of the group of low healthy trees that could be found. The dead line was represented by the lowest dying or sickly tree that still showed some sign of life.

As a general rule, no dead trees were recorded except those that died during the survey period. On this basis for establishing the healthy line and the dead line, it is obvious that some sick or dead specimens of a species might overlap into the lower part of the healthy zone. According to field records and observations, all individuals below the dead line were dead. The range between the healthy line and the dead line is the transition or sickly zone. For some species, such as sweetgum, the healthy line and the dead line were separated by about three feet vertically. For species like pawpaw, the two lines coincided and for all practical purposes there was no sickly zone.

Table 4.—Summary of Effects of Flooding upon Bottomland Forests, West Sandy Project—Kentucky Reservoir

Zone	Contours between elevations	Percent of time flooded during growing seasons (Apr. 1–Oct. 1)	Effects of flooding
I	343 ft.–346 ft.	54–99	All woody species killed. Dead snags standing, tops mostly fallen. These specimens started dying in 1945.
II	346 ft.–348 ft.	41–54	High mortality of most species but living specimens of swamp ironwood (*Planera aquatica*), overcup oak, black willow, and sweet gum present. Snags and some dead trees with tops present depending on species prevalent in area.
III	348 ft.–355 ft.	16–41	Zone in which the number of species surviving increases up to band formed by healthy stands of ironwood (*Carpinus caroliniana*) (about 355 ft.). Snags and dead trees with some tops present, top fall moderate.
IV	355 ft.–359 ft.	1–16	Zone in which the number of species surviving progressively increases with an increase in elevation until normal forests are reached at approximately the 359 foot contour. The beech and other woody species in the upper part of this zone were flooded during the growing season of 1951 and some died during 1952. The dead trees were standing with tops and twigs intact and little or no top fall has occurred, at least, in the upper part of this zone.
V	359 ft.–360 ft.	0– 1	Zone in which survival almost complete, but with some dead dogwood, yellow poplar, and hornbeam occurring, particularly in the lower part of this zone.

Criteria for healthy specimens included well developed foliage of normal color, retention of fruiting bodies, absence of adventitious shoots along the trunks, and no dieback. Although increment borings were not included in the West Sandy studies, Green (*4*) reports that near Clinton, Ill., permanently flooded trees continued to grow at near normal rates until they died.

In general, specimens three inches d.b.h. or larger were sampled wherever possible. But for certain species, such as buttonball, holly, pawpaw, dogwood, and redcedar, specimens usually fell in a smaller size class.

Elevation ranges showing the lowest healthy tree and the lowest sickly tree (healthy and dead lines) for the various species and the percentage of time these contours were flooded during the growing season are summarized in Table 3. Species are arranged in order of increasing tolerance to flooding, as based on the lowest healthy tree.

The relative importance of flooding during the growing and dormant seasons was also considered. Flooding the root crowns of beech during the summertime for a continuous period of about two weeks was sufficient to kill large specimens. The selective killing of beech by short periods of summertime flooding has been observed elsewhere in Kentucky Reservoir and also in Pickwick Reservoir. However, during January and February 1950, water covered the 361-foot contour continuously for 18 days, reaching a maximum depth of about eight feet at this elevation. This relatively deep winter flooding had no apparent adverse effects on beech. Somewhat similar results were observed for yellow-poplar and dogwood, which were found to be even less tolerant of flooding than beech. The occurrence of large specimens of these three species might well be used as indicators of sites relatively free of flooding during the growing season, or at least during the summer months.

Observations of plantations in the Kentucky Reservoir area periodically subjected to long periods of complete inundation during the dormant period show little or no adverse effects on sweetgum, green ash, sycamore, and other bottom-

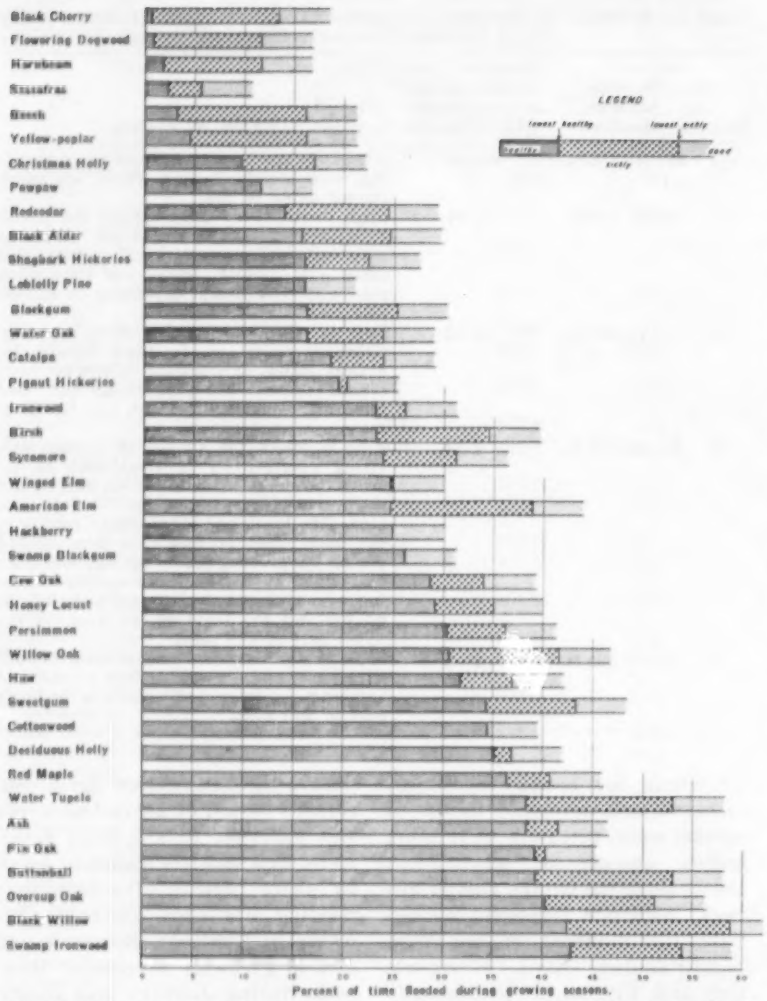

FIG. 1.—Tolerance of woody species to flooding in the West Sandy Dewatering Project, September 1, 1944, to July 1, 1952, during April 1—October 1 for all growing seasons.

land species. On the basis of these observations, it is concluded that, in general, periodic winter flooding is of little significance in the survival of bottomland trees, and that flooding during the growing season is mainly responsible for the death and injury observed. Although this conclusion appears valid, the data are too limited to clearly separate the possible additive effects of wintertime and summertime flooding. However, other studies tend to substantiate it (*5*, *6*, *7*). The percent of time that the healthy line and dead line for each species were flooded during successive growing seasons (September 1, 1944, to July 1, 1952) was determined and plotted.

Table 3 shows a vertical stratification by contour zones in the survival of the various species studied. Black cherry was most intolerant of flooding and swamp ironwood most tolerant. The survival contours of these two species were separated by approximately 12 feet vertically, with the percent of time flooded during the successive growing seasons being 0.6 percent and 42.9 percent, respectively. At elevations above those of affected black cherry, flooding had no noticeable effects on woody species. Below the dead line elevation for black willow, all woody species were killed.

Seedlings of forest species germinate in abundance at West Sandy during favorable dewatered periods. During the 1946 growing season, TVA foresters found some 9,000 seedlings per acre of the following species below the 349-foot contour: blue beech, water oak, American elm, sweetgum, willow oak, blackgum, hawthorn, winged elm, and deciduous holly. An inspection of the area in 1952 showed no stands of six- or seven-year-old reproduction between elevations 343 feet and 347 feet, and apparently none between elevations 347 feet and 349 feet. However, recently germinated seedlings were abundant, including black willow, overcup oak, swamp ironwood, red maple, elm, green ash, water tupelo, blackgum, birch, and sweetgum.

Water- and wind-borne seeds are plentiful in the bottoms and some seedlings apparently germinate annually during favorable periods of dewatering, but effective establishment is almost invariably prevented by subsequent adverse water levels. This condition appears to be most prevalent in the lower half of the basin where most of the timber has been killed. The only exception is willow, which has become established and has survived down to near the 347-foot contour. These observations suggest that seedlings of most species do not survive conditions which established specimens cannot tolerate. Thus, native or planted stock would not be expected to survive unless the area is effectively dewatered during growing seasons.

In this respect, it should be pointed out that chances for survival appear to be greater if the tops of the plants project above the water. For example, buttonball is generally recognized as being more water tolerant than black willow, but where the two species occurred side by side and were flooded, the taller willow survived and the shorter buttonball was killed. In this case, the buttonball was completely flooded but the willow tops projected into the air. Other observations show that on sites where the willow was completely covered by water and buttonball was not, the willow succumbed and the buttonball lived. This suggests that

for species having a similar water tolerance, taller plants probably have a greater chance of survival than shorter ones, particularly under the conditions of relatively deep flooding.

Through the combination of air and ground reconnaissance and a detailed instrument survey and plant study on the ground, five main zones were delineated in the West Sandy project during the 1952 season. These zones are described in Table 4. Some exceptions occur within the zones depending upon the relative susceptibility of forest components to flooding.

Summary

The West Sandy dewatering project has operated more or less as an uncleared or partially cleared flood control reservoir with fixed maximum discharge. Flooding has had an adverse effect on bottomland forests, and much of the timber in the storage basin has been killed. The tolerance of 39 woody species to periodic flooding was determined. All woody species were killed where the root crowns were periodically flooded more than 54 percent of the time during all the growing seasons the project had been in operation. However, these species subjected to less flooding at higher elevations showed varying degrees of tolerance with survival contours stratified over some 12 feet vertically.

The effects of flooding on woody plants are summarized graphically by plotting survival data for each species against the percent of time of flooding during the growing seasons. Attention was focused on the growing seasons because at this time surface water exerts its major adverse effects on woody components of bottomland forests.

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Use of an Increment Measuring Scale for Measuring Growth in Ponderosa Pine

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In an inventory of timber on approximately 535,000 acres of cutover ponderosa pine lands on the Klamath Indian Reservation, Oregon, measurements of growth, as well as of volume, were obtained. These growth measurements, which are taken from increment borings, are recorded on IBM "mark sensing" cards. This system of card inventory, which utilizes one card for each merchantable tree to be measured, allows the recording of a present diameter breast height for each tree, as well as a diameter (or diameters) for the same tree at the end of any growing season (or seasons) in the past. This information is recorded on the card for the respective tree. When all measurements have been recorded, the cards are machine processed to yield the desired information on present volumes and growth, with but a minimum amount of office work.

It is the purpose of this article to describe the method employed in the field to obtain the d.b.h. measurement of a tree at the end of any year in the past by the use of an increment measuring scale. The difference between the past d.b.h. and the present d.b.h. will, of course, be a measure of the growth of the tree. Although similar methods for measuring growth may have been used elsewhere, this scale was developed without reference to any previous work. Since its use permits the rapid measurement and recording of growth in the field at the time the boring is made, it may be worthy of consideration on other projects.

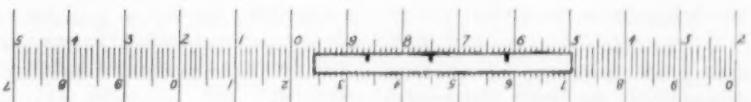

Fig. 1.—Increment measuring scale, showing how an increment core from a tree with a present d.b.h. of 29.4 inches would be placed on the scale to obtain past d.b.h. measurements. Assuming that the boring had been made during the 1953 growing season, the points marked on the core would represent the ends of the 1945, 1935, and 1925 growing seasons.

The use of the scale to determine the d.b.h. of a tree at the end of any growng season in the past is accomplished as follows:

1. The present d.b.h. of the tree is measured to the tenth of an inch, using either diameter tape or calipers.

2. An increment boring is then made in the tree and the core extracted.

3. The bark and cambium layer are removed from the core and the core is marked at the point (or points) representing the end of the growing season (or seasons) at which it is desired to determine

TABLE 1.—COMPARISON OF PAST D.B.H. MEASUREMENTS OF PONDEROSA PINE TREES OBTAINED BY USE OF INCREMENT MEASURING SCALE WITH MORE ACCURATE DETERMINATION OF THE SAME DIAMETERS USING THE KEEN-GRANT FORMULAS TO COMPENSATE FOR BARK GROWTH[1]

Keen's ponderosa pine tree classification	Method for determination of past d.b.h.	Present (1953) d.b.h.	D.b.h. (inches) at end of year: 1950	1945	1940	1935	1930
1A	Increment scale	20.0	18.8	17.3	15.8	14.3	13.0
	Keen-Grant formulas	20.00	18.84	17.26	15.85	14.30	13.01
4C	Increment scale	26.0	25.8	25.5	25.3	25.0	24.7
	Keen-Grant formulas	26.00	25.82	25.54	25.29	25.03	24.73
3B	Increment scale	37.0	36.4	35.6	34.9	34.2	33.4
	Keen-Grant formulas	37.00	36.42	35.62	34.88	34.19	33.43
2A	Increment scale	18.0	16.8	15.6	14.6	13.5	12.6
	Keen-Grant formulas	18.00	16.77	15.57	14.56	13.47	12.55

[1]All measurements of growth made on simulated increment cores.

what the d.b.h. of the tree had been.

4. The core is then placed on the increment measuring scale in such a position that the outer layer of wood, from which the bark and cambium have just been removed, matches the point on the scale corresponding to the present d.b.h. of the tree. (See Fig. 1.) Since the first digits of the numbers on the scale have been omitted, the point that reads 9.6 on the scale applies equally well to 29.6, 19.6, or 09.6 inches. From the point where the outer layer of wood matches the present d.b.h. on the scale, the body of the core should extend toward lower figures on the scale.

5. The diameter at the end of the past growing season is read from the scale at the point (or points) where the core has been marked in Step 3. The first digit, corresponding to the first digit of the present diameter, is supplied to the reading taken from the scale.

As an example, suppose that the d.b.h. of a tree has been measured (Step 1) as 29.6 inches during the 1953 growing season and it is desired to find out what the d.b.h. of the tree was at the end of 1945, 1935, and 1925. After boring the tree (Step 2) the bark and cambium layer on the increment core are carefully removed from the outer layer of wood and the points on the core corresponding to the end of the 1945, 1935, and 1925 growing seasons are marked (Step 3). Figure 1 shows the manner in which the core would be marked. It also illustrates the method for laying the core on the scale, with the outer layer of wood matching the present d.b.h., (2)9.6, on the scale (Step 4). With the core held in this position the d.b.h. at the end of 1945, 1935, and 1925 are read from the scale (Step 5) as (2)8.6, (2)7.5, and (2)6.1 inches, respectively.

The scale has been designed to read with either edge up. With the scale held as shown in Figure 1, the numerals toward the upper edge read in descending order from 5.0 at the left end. With the scale turned around it reads in descending order from 0.0. This provides enough overlap in diameter ranges between the two sets of readings to allow a person to select the one that will provide the desired range of diameters.

This scale was made especially for ponderosa pine. It is, in effect, a rapid means for subtracting double the radial growth from the present d.b.h. in order to obtain the diameter at any desired time in the past. However, since an allowance for the growth of ponderosa pine bark, from formulas as determined by Keen and Grant[1] in 1941, has been incorporated in the scales, it becomes somewhat less accurate for use in determining past d.b.h. measurements of other species. The relative complexities of the Keen-Grant bark formulas, which include factors for Keen's age class and vigor rating, were interpreted on the scale by reducing the graduations by eight percent to allow for the increase in bark thickness as the tree became older.

Before accepting the relative accuracy of this allowance for thickness in bark, a series of measurements were conducted on simulated increment cores marked off on paper. Using the scale, with its reduction of eight percent to allow for bark growth, and comparing its measurements of past d.b.h. with those obtained with the use of the two Keen-Grant bark formulas (one for bark thickness related to d.b.h. outside bark, the other for the same relationship to the inside bark d.b.h.) it was found that the two methods agreed very closely (Table 1).

In calculating the bark thicknesses by use of the Keen-Grant formulas to determine the past d.b.h. measurements of trees in Table 1, the age classes and vigor ratings of each sample were considered to be unchanged during the period for which growth was being measured. Actually, during the period there would have been a slight increase in the past d.b.h. measurements had an allowance been made for the partial age class differences between the past and present d.b.h. measurements. This difference would approximate only .04 inch during a 25 year period.

The comparisons noted in the table verified the belief that the increment measuring scale would be satisfactory for obtaining past d.b.h. measurements to accuracies of tenths of inches. This was considered to be of sufficient accuracy for the present management purposes, although further refinements might be desirable if the scale were to be used in more scientific research.

[1]Reported in Appendix B of the Forest Service publication entitled "Calculating the Growth of Ponderosa Pine Forests" by Philip A. Briegleb, December 28, 1945. The formulas developed by Keen and Grant, from 1,437 bark measurements in ponderosa pine, are as follows:

Double bark thickness at breast height for ponderosa pine in inches = (1) .0787 d.b.h. ob $-$ (.1615 $\times$ age class) $-$ (.1235 $\times$ vigor class) + 1.981; (2) .08542 d.b.h. inside bark $-$ (.1615 $\times$ age class) $-$ (.1235 $\times$ vigor class) + 2.0869. (Vigor classes are expressed by the numerical values 1, 2, 3, and 4 for Keen's ponderosa pine vigor classes A, B, C, and D, respectively.)

Notes

Diameter Increase After Thinning White Oak Sprouts to One Stem

The management of hardwoods of sprout origin is, and will continue to be, a problem in the Virginia Piedmont. Surveys on the Lee Experimental Forest in Buckingham County, Va., have shown that in some hardwood stands more than 80 percent of the stems are of sprout origin. There are many stands of low-grade hardwood on the Piedmont today which have resulted from the prevalent practice of cutting small saw logs and leaving slow-growing defective smaller trees and sprout reproduction to occupy the site. Proper management of sprout stands could be an asset in this region of small-saw-log forestry.

A major problem of management, therefore, is the proper treatment of sprout clumps. Natural thinning in white and chestnut oak, which comprise a large percentage of these stands, is very slow. Twin trees of saw-log size are common and 40- or 50-year-old clumps of multiple stems are not rare. This close grouping of trees results in poor form and possibly reduced growth. Single-stemmed sprouts in one 25-year-old white oak sprout stand average about an inch larger in diameter than the largest trees in multiple-stemmed clumps.

Several recommendations have been made concerning the thinning of sprout clumps to a single stem. Downs (*1*) points out that such a procedure reduces loss of lumber scale in harvest. Hepting (*2*) recommends thinning the sprout clump to a single low-origin sprout at 8 to 15 years to reduce butt rot and to provide better spacing. Jemison and Hepting (*3*) give specific, well founded recommendations for reducing sprout clumps to single stems but do not discuss effect of companion-sprout removal on growth rate of remaining stems. In Iowa, Joranson and Kuenzel (*4*) reported that thinning sprout clumps results in greater growth of the surviving sprout but no growth data were presented. Wahlenberg (*5*) has shown the desirability of quality selection as a means of rehabilitating depleted hardwood stands.

In 1949, A. A. Downs, then with the Southeastern Forest Experiment Station, undertook a study to determine quantitatively the effect on growth rate when white oak sprout clumps were thinned to one stem.

Downs used an even-aged 25-year-old stand of white oak on the Lee Experimental Forest. This stand was on a Nason fine sandy loam soil on a gentle uneroded slope and was composed mostly of sprout clumps. The dominant stems averaged about 5 inches in diameter, the crowns were closed, and radial growth had started to fall off.

One hundred thirty-two sprout clumps were selected within this stand. Half of these clumps were so chosen that the two largest stems were of equal dominance, both being either dominant or codominant, and the difference in diameter between these two stems did not exceed 0.3 inch. The remaining 66 sprout clumps had the two largest stems of unequal diameter. In this group the larger stem was either dominant or codominant with the smaller not less than intermediate. The difference in diameter between the two largest stems of the clump was not less than 0.7 inch but no more than 1.3 inches.

In each of these two groups a random selection was made designating half of the clumps for treatment. The treatment consisted of cutting all stems in the clump except the one largest in diameter. If two stems had identical diameter, the better tree from the standpoint of crown, height, and form was left. The cutting was done as low as possible without injuring the remaining stem. The remaining 33 clumps in each group were designated as checks, in which the crop tree was selected, marked, and measured but no cutting was done. Diameter, height, crown ratio, and crown width were recorded for each tree.

An examination of these trees was made after six full growing seasons. There had been no mortality, and the height and diameter only were recorded for each tree. The results of this measurement are given in Table 1.

Table 1.—Six-Year Growth of Treated and Untreated Stems

	D.b.h. 1947	D.b.h. 1953	6-year d.b.h. growth	Height 1947	Height 1953	6-year height growth
	Inches	*Inches*	*Inches*	*Feet*	*Feet*	*Feet*
Clumps with equal-sized stems						
Check	5.04	5.59	0.55	36.4	40.4	4.0
Treated	4.88	5.96	1.08	36.1	40.0	3.9
Clumps with unequal-sized stems						
Check	5.25	5.89	.64	36.4	40.2	3.9
Treated	5.41	6.33	.92	37.3	41.2	3.9

As shown in the table, the reduction of the sprout clump to the single largest stem resulted in appreciably greater diameter growth than that of comparable stems on unthinned clumps. In those clumps which had dominants of equal size, the growth in diameter of the stem benefiting from the treatment was double that of the untreated sprout. In clumps where there was already a distinctly dominant sprout stem the diameter growth of this stem was 50 percent greater when all other sprouts were removed than when no cutting was done.

The cutting of all competing

stems of a sprout clump had no statistically significant effect on the rate of height growth of the remaining crop trees.

The reduction of oak sprout clumps to a single desirable stem at a fairly early age is generally recommended on the basis of the resulting improvement of the quality of the stand. This study has shown that this cultural treatment also results in substantial increase in the diameter growth of the remaining stems.

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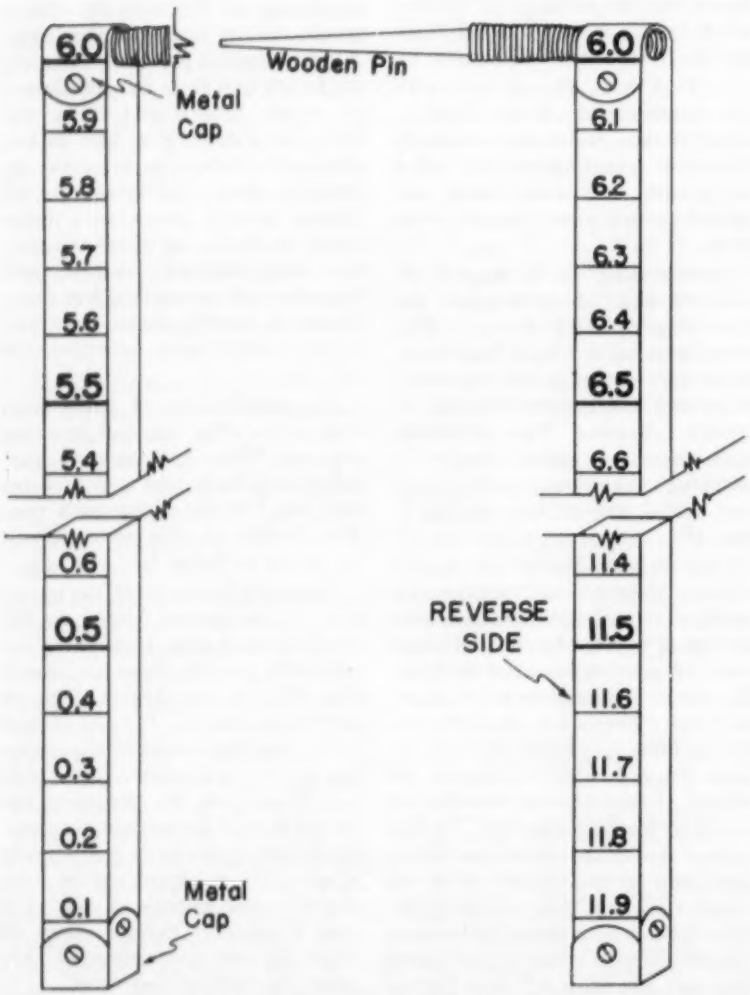

FIG. 1.—This 6-foot measuring pole is easy to make and use. Measurements up to 12 feet can be taken rapidly and accurately.

A New Pole for Measuring Small Trees

In many research projects—particularly those dealing with young plantations—heights of small trees must be measured accurately to the nearest inch or one-tenth foot. A new type pole for measuring such trees has been developed at the Columbia (Missouri) Research Center of the Central States Forest Experiment Station. This pole has two features that make it superior to most measuring poles. First, the scales on it are so arranged that, although the pole is only 6 feet long, it can be used to measure trees up to 12 feet in height. The second advantage is a flexible arm, attached at right angles to the top of the pole, that enables the operator to tell when the end of the pole is exactly as high as the top of the tree. This pole has been used for several years and has been found to be an accurate and efficient tool.

The pole is made from a stick of fairly strong wood approximately 6 feet by 1 inch by ½ inch (Fig. 1). Copper or aluminum caps are fastened on the bottom and top of the pole to keep the ends from splitting and wearing.

The arm is about 6 inches long and is made from a coil spring and a tapered light-weight wooden pin. The coil spring makes the arm flexible so it will not catch or hang on branches; it should be lighter than a common screendoor spring but strong enough to support the weight of the wooden pin. A groove for the spring is cut across the top end of the pole. The spring is set in this groove, fastened to the pole with a small box nail, and held in place and protected by the metal cap. When the spring is in place the distance from the bottom of the pole to the bottom of the spring should be exactly 6 feet.

The pole is painted silver or white and the scale put on with India ink or black paint. The scale from 0 to 6 feet reads from the bottom up. The scale from 6 to 12 feet is on the reverse side and reads from the top down. A coat of clear varnish or plastic-type finish will protect the scale.

For measuring trees up to 6 feet in height, the operator places the pole parallel to the stem and reads height directly from the 0-to-6-foot scale. For trees higher than 6 feet, he starts out in the same way and finds the 6-foot point on the stem of the tree. Holding this point with his thumb, he moves the pole with the inverted 6-to-12-foot scale facing him, up along the stem until the arm rests on or is aligned with the top of the tree. Then he reads the total tree height directly from the 6-to-12-foot scale opposite the 6-foot point on the stem.

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Development of Longleaf Pine Seedlings Near Large Trees

A recent study in south Mississippi indicates that, if litter is removed periodically, the survival of longleaf pine seedlings (*Pinus palustris* Mill.) for 5 years after establishment is not seriously lowered by competition from large trees. This seems true whether the overstory trees are residual longleaf seed trees, second-growth longleaf seed trees, or upland oaks. The difference between these results and those of earlier investigations[1] suggests that litter may be harmful—either through a smothering effect or because it creates hotter fires.

Methods

The heavy catch of long-leaf reproduction (obtained on fresh burns) from the 1947 and 1948 seed crops provided adequate seedlings for the study. When the plots were laid out in the spring of 1949, all competing trees were open-grown with thrifty crowns. Average crown widths of the 3 classes of competing trees were 17.5 feet for old-growth pines; 22.3 feet for second-growth pines; and 28.6 feet for hardwoods. These trees ranged from 10 to 19 inches d.b.h., and were fairly representative of the larger trees found in open longleaf stands. The old-growth pines were residuals that had been suppressed until the merchantable stand was harvested about 40 years ago.

All together, 29 competing trees were in the study—12 pines and 5 hardwoods on the Harrison Experimental Forest, in Harrison county, and 12 pines on the McNeill Experimental Forest, 30 miles to the west.

Longleaf seedlings were studied within a circular area around each large tree. This large circle had a 30-foot radius and was divided into 3 concentric zones each 10 feet wide. Three rectangular plots were established on selected radii of the large circle, with one plot in each zone. In addition, 12 plots—6 on the McNeill and 6 on the Harrison—were located in the open. Thus there were 99 plots in all—87 near overstory trees and 12 in the open.

About half of the plots were stocked with seedlings from the 1947 seed crop and half with seedlings from the 1948 crop. Plots varied in size but averaged about 5 feet on a side. When the study began each plot had 20 seedlings.

Study area soils were deep, fine sandy loams, except that the 1948 old-growth plots at McNeill were on an eroding slope. After the study was installed, all seedlings were sprayed periodically to reduce the brown spot needle disease. When the 1950, 1951, and 1952 examinations were made, most of the litter and dead herbage was removed from the plots to facilitate seedling measurement. In June 1952, all plots were thinned to 10 seedlings to reduce competition among seedlings.

Results

Seedling survival for the 3-year period ending in June 1952 ranged from 80 to 100 percent (Table 1). It was considered adequate under all conditions, and variations between plots were not consistent. Rainfall was generally favorable throughout the study and in most cases the cause of mortality was not determined.

In October 1953, the average root-collar diameter was 0.53 inch for all seedlings near hardwood trees, 0.56 for all those near old-growth seed trees, and 0.60 for all those near second-growth seed trees (Table 2). Under the conditions of this test, then, large hardwoods seemed to provide the severest competition for longleaf seedlings and second-growth seed trees the least.

Table 1.—Seedling Survival in June 1952[1] (in percent of initial stocking)

Competition	1947 seedlings		1948 seedlings	
	Harrison	McNeill	Harrison	McNeill
	Percent			
Old longleaf				
0-10-foot zone	87	95	92	80
10-20-foot zone	98	98	95	82
20-30-foot zone	90	100	92	80
Second-growth longleaf				
0-10-foot zone	97	97	90	93
10-20-foot zone	90	95	92	90
20-30-foot zone	97	88	93	95
Hardwood				
0-10-foot zone	95	—	85	—
10-20-foot zone	83	—	88	—
20-30-foot zone	83	—	95	—
Check (open)	95	100	90	83

[1] Between June 1952 and October 1953, additional mortality was only about one percent.

[1] Chapman, H. H., and Robert Bulchis. Increased growth of long-leaf pine seed trees at Urania, La., after release cutting. Jour. Forestry 38:722-726. 1940.
Bruce, David, and C. Allen Bickford. Use of fire in natural regeneration of longleaf pine. Jour. Forestry 48:114-117. 1950.

TABLE 2.—AVERAGE ROOT-COLLAR DIAMETER OF SEEDLINGS IN OCTOBER 1953

Competition	1947 seedlings		1948 seedlings	
	Harrison	McNeill	Harrison	McNeill
	Inch			
Old longleaf				
0-10-foot zone	0.56	0.49	0.65	0.33
10-20-foot zone	.59	.64	.64	.38
20-30-foot zone	.64	.66	.65	.46
Second-growth longleaf				
0-10-foot zone	.54	.55	.55	.39
10-20-foot zone	.63	.66	.71	.43
20-30-foot zone	.74	.83	.68	.50
Hardwood				
0-10-foot zone	.53	—	.41	—
10-20-foot zone	.59	—	.50	—
20-30-foot zone	.61	—	.54	—
Check (open)	.64	.73	.76	.46

TABLE 3.—SEEDLINGS THAT HAD STARTED HEIGHT GROWTH IN OCTOBER 1953 (PERCENT OF TOTAL LIVING SEEDLINGS)

Competition	1947 seedlings		1948 seedlings	
	Harrison	McNeill	Harrison	McNeill
	Percent			
Old longleaf				
0-10-foot zone	3	7	30	0
10-20-foot zone	3	20	20	0
20-30-foot zone	20	33	27	4
Second-growth longleaf				
0-10-foot zone	3	0	7	0
10-20-foot zone	3	13	13	0
20-30-foot zone	37	47	13	0
Hardwood				
0-10-foot zone	10	—	0	—
10-20-foot zone	15	—	0	—
20-30-foot zone	15	—	5	—
Check (open)	20	31	20	0

Longleaf seedlings begin active height growth when they attain a root-cellar diameter of about one inch. In October 1953, 18 percent of the check seedlings had started height growth, as compared with 14 percent of the seedlings near old-growth seed trees, 11 percent of those near second-growth trees, and 8 percent of those near large hardwoods (Table 3). In general, the 20 to 30-foot competition zone had the largest percentage of seedlings making height growth.

Conclusion

Although large pine and oak trees should be removed from longleaf seedling stands as soon as feasible, this study indicates that they may be left for 5 or 6 years without serious mortality among the reproduction.

The proportion of seedlings initiating height growth at 5 or 6 years of age, however, was affected by overstory competition. The effect tended to vary directly with distance from large trees. Hardwoods retarded height growth the most, then second-growth longleaf, and then old-growth longleaf. Root-collar diameters of seedlings definitely increased with distance from large trees, with hardwoods having the greatest suppressing effect and second-growth longleaf the least.

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Points of View

Reply to Comments on "Harvesting Technique"

The article commented on by Mr. Smith[1] attempted to determine *approximate* economic values present in the Engelmann spruce—subalpine fir type on the *Western Slope of Colorado*. It is granted that the procedures used in ascertaining economic values may not conform to the usual pattern established for stumpage computations. However, it appeared rather ridiculous to me to carry timber values to the last decimal point when other values were partially based on estimates. My crude economic determinations presented all values with equal reliability merely indicating their relative importance.

I would take specific exception to Mr. Smith's estimate of a growth rate of 100 bd. ft. per acre per year. The best available computations on growth for the area studied indicated only 25 bd. ft. per acre per year which points up the error of projecting conditions from one part of the country to another. Foresters with multi-regional experience quickly recognize the misinterpretations that such projections may yield.

As Mr. Smith points out there is a real need for research in land-use valuation. If thinking along this line has been stimulated, the article has produced an unexpected dividend.

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[1]Smith, J. H. G. Comments on "A harvesting technique for beetle-killed Engelmann spruce on the Western Slope of Colorado. Jour. Forestry 53:208-209. 1955.

Reviews

Conserving Natural Resources: Principles and Practice in a Democracy

By Shirley W. Allen. 347 pp. Illus. McGraw-Hill Book Company, New York 36, N. Y. 1955. $5.50.

A dynamic new text which is likely to become more appreciated by both teachers and students as it is used, this book is an important contribution to natural resources management.

Two features distinguish it from previously published books. One is a discussion of the policies of natural resource management in a democratic form of government, a matter which heretofore has been given too little attention. Another innovation is a supplemental teachers' manual which indicates the major tenets of each chapter and provides outlines for length courses with sample examination questions. This should be particularly useful to teachers faced with the task of orienting students to a subject with such a broad scope.

The author has faith in the American way of life to work out its problems in natural resource use. He illustrates "principles and practice in a democracy" although his description is likely to be too subtle for the average college student. However, as the chief function of this text is educational the manual will enable the instructor to explain important social aspects of natural resource management.

The arrangement of the book is orderly and proceeds from a consideration of the basic resources—climate, water, and soil—to a treatment of the dependent resources—forests, grasslands, wildlife, and man. Both replaceable and irreplaceable resources are classified and described. A chapter is devoted to mineral resources. A bibliography is appended at the end of each chapter.

Illustrations are carefully selected and well reproduced. Diagrams and charts are used advantageously to illustrate conservation principles, practices, and statistics on natural resources. Concepts and ideas are also graphically presented.

Conserving Natural Resources presents a treatment of the subject of "human powers" which has not appeared in previously published texts of similar scope. This area is somewhat new to conservationists and Prof. Allen is to be complimented for its inclusion. The implications of overpopulation could have been more clear and tied in more substantially with population control and the maintenance of resource productivity.

A clear and affirmative view that America still has an abundance of resources is offered to the reader with logical reasons why proper use and management are imperative to our security. Forthright opinions are proffered about governmental conservation policy which will be of increasing historical significance. The clear stand taken on matters of policy, past and present, are important to student and teacher alike in that they provide a datum upon which to base discussion.

Prof. Allen has been successful in meeting his writing objectives. The text is suitably tuned to all college levels. It can readily be presented either as a major or a minor course with the aid of the teacher's manual. Years of teaching experience have enabled the author to adapt the book to several levels of instruction by means of this supplement. He describes quarter and semester courses at the two-, three-, or four-credit level with chapter by chapter suggestions about "What to emphasize." This should prove helpful to even an experienced teacher. Instructors now conducting courses in conservation would profit by consulting *Conserving Natural Resources.*

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The Field Study of Place: A Practical Guide.

By A. J. Wraight. 98 pp. Illus. University Press, Washington 4, D. C. 1954. $2.25.

The relationship between "place" and "field study" in respect to the development of an investigation is aptly clarified and explained by the author in the opening chapter.

"Place," being a common term, refers to anything from a building to an entire country. This may be visualized as a definite part of the earth's surface which is delimited by the needs of an investigation. "Field study" is explained as being the collecting of information at first hand about a particular area of land or "place."

But, before any detailed field study is undertaken, beyond a familiarizing trip or tour, a preliminary evaluation of the project should be made. To develop this phase, the author indicates sources, and then outlines the way to go about searching out and using pertinent material obtained from them.

Following this preliminary research, enough information should have been gathered and analyzed to point up any necessity for a field study.

The author indicates four field methods to choose from, and gives full explanation of what should determine the method to be used. Some of the factors taken into consideration are the amount of work to be done; size and shape of the area; length of time required; available finances; and the degree of accuracy desired in the results.

Field equipment suitable for use with each of the four methods is discussed. Additional sources are listed for further instruction in the use of the more complex instruments. The degree of accuracy to be expected from those to be used is pointed out. Actual field study is presented, step by step, for each method.

Next, a special discussion of multiple feature mapping is well pre-

sented and clearly reveals an easy way of expediting, when possible, the field mapping of complex detail.

Emphasis in the last chapter is on the all important final report. A simple approach, in four phases, for the completion of this report is given.

Selected references and an appendix with stadia tables are found at the end of the book An index for the layman or fieldman rounds out the treatise.

The inclusion of working tables pertinent to field reconnaissance and survey, such as conversion values for linear measure of area to that of surveyors' chain measure, would be very helpful.

This book should be useful to those who need to undertake a field investigation and submit a report, yet do not have professional training for such work. The student may very well find much to learn from reviewing the book.

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Forest Research in New England

By the Subcommittee on Forest Research, New England Council Committee on Forestry and Wood Industries. 64 pp. Northeastern Wood Utilization Council, Inc., New Haven, Conn. 1954. $2.

Prepared by the New England Council's Subcommittee on Forest Research, this publication is a report to the Council's Committee on Forestry and Wood Industries. Instructions to the subcommittee directed it to make not only an inventory of the research projects under way, "but also to evaluate their effectiveness, whether current research was meeting the needs for the future as well as the present, and to suggest what additional work should be done."

The report is timely in that nearly twenty years have passed since a similar survey was conducted—and then only as part of a national effort.

The subcommittee, with H. I. Baldwin as chairman, divided the forest-research field into 10 classes, selecting specialists to cover each class or group. Each group leader was left to select assistants to cover further specialties in his field. Thus, a task force of 14 men had a direct hand in the preparation of the report.

The tables presented by several of the group leaders are highly informative. However, a summary table showing all research projects under way in New England in the 10 fields of forest research, and the agencies responsible for them, would have added materially to the value of the report.

An impressive volume of forest research is under way in New England. Substantial sums are being spent yearly by federal, state, and private agencies. What is most needed, however, is better coordination of research effort and more cooperative research, particularly on complex problems that call for simultaneous attack on several fronts.

That some fields of forest research have progressed farther than others is clearly evident. Silviculture and protection (insects and disease as well as fire) have made long strides forward. In many fields knowledge is far ahead of practice, and the greatest need is for application of results already obtained.

The subcommittee regards its survey as the first step in the development of a more effective forest-research program for New England. The next step—to formulate the major forest problems of New England and assign them priorities—it considers to be the function of the New England Council. To implement such a program the subcommittee makes the following commendatory recommendations:—

1. The Committee on Forestry and Wood Industries should outline a comprehensive plan of objectives and the steps to be taken in attaining them.
2. A plan of research should be drawn up in cooperation with existing advisory research committees.
3. Each major problem should have a coordinating committee that would be a continuing clearing house for information and would keep up to date on the subject. Examples are reports on blister rust resistant white pines, the white pine weevil subcommittee, and groups concerned with forest genetics and forest soils.

The authors of this report deserve high praise for their contribution to New England forestry.

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The Improved Nut Trees of North America and How to Grow Them

By Clarence A. Reed and John Davidson. 404 pp. Illus. Devin-Adair Company, New York 10, N. Y. 1954. $6.

This book deals with nut trees and their culture. It includes wild and selected native nut trees as well as standard named varieties.

For our native species it gives their range of distribution and their most striking taxonomic characteristics. For the improved named varieties it gives their origin and history, fruiting habits, and taxonomic characteristics, as well as their climatic and soil requirements. Attempts are made to advise in what sections of our country successful nut-bearing orchards might be established.

One-third of the book concerns itself with cultural practices, applicable for all sections of the country. It discusses planting, grafting, pruning, fertilizing, pest control, the harvesting and curing of nut-tree crops. The book is well illustrated.

The culmination of many years of work with nut trees by the joint authors, the publication is a befitting memorial to them. The late Clarence A. Reed, who initiated the book, died in 1950. Upon her husband's death Mrs. Reed made available all his writings on nut species as well as his excellent photographs to the junior author, John Davidson. The latter completed the manuscript in the spring of 1954, just a month before his death. In addition to their wide acquaintance with nut growers throughout the country, both men enjoyed a rich background of practical experience in growing nut trees of various kinds for a period of over forty years.

Originally the senior author had intended "to write a full-bodied, definitive treatise on the Eastern (American) black walnut." The junior author, in revising and editing the voluminous material accumulated by Reed, decided to include this part in its entirety, fully one-fourth of the book. At the end of most sections there is listed collateral reading. Of the 172 references, over 50 of them refer to articles published in the Northern Nut Growers' Association *Proceedings*.

While this book is reputed to be the most complete manual on nut culture available at present, it does not settle all problems, as the publishers imply on the inside front of the jacket. The closing sentence in the book reads, "Plant your trees in good soil, feed them well, and they will resist their enemies." There are still abroad, both insect and plant diseases, that lay low the best fed hosts. None of us have forgotten the classic example of the chestnut blight.

J. Russell Smith in the introduction states that the chief value of this book is "The amateur experimenting tree lover can save years by learning what he probably can and cannot do. There are hundreds of these private experimenters who will profit by the careful reading of this book. The professional horticulturist will doubtless also find guideposts in it." Foresters would do well to go to other sources for technical information.

Jesse D. Diller

World Pulp and Paper Resources and Prospects

Prepared by FAO of UN. 102 pp. U. S. Sales Agent: Columbia Univ. Press, New York, N. Y. 1954. $1.25.

There has been a growing concern in recent years over the fact that Europe and North America, with less than one quarter of the world's population, produce 90 percent of the world supply of paper and board, and consume 86 percent of it. It has been thought that a more equitable distribution of production and consumption with other regions of the world is a necessary concomittant of any world-wide rise in the cultural and standard-of-living level.

To delineate the situation this publication presents world production-consumption data on a regional basis for pulp and paper from 1913 through the period 1950-1952. Furthermore, it estimates potential demand in 1960-1962 and the possibilities of meeting that demand. It is of primary interest to forest economists and to those who look to forest economics for a sound basis for decisions in the field of forest policy.

On the basis of this analysis, the conclusion is reached that countries presently active in pulp and paper production will not be able to expand output sufficiently to keep pace with rising export as well as domestic demand. Therefore, production in countries now importing the great majority of their pulp and paper will have to be expanded to an even greater extent than called for by present plans. It is believed that fibrous resources are not the limiting factors in production expansion; rather, other economic and environmental factors operate to do this.

Following 6 chapters devoted to the background of the study and an analysis of pertinent data, 6 appendices provide a more detailed treatment of certain statistical and technical information presented in the body of the work.

First making an analysis of potential demand, the authors interpose a chapter on pulp and paper production from 1913 to 1950-1952 before going on to discuss the possibilities of the several regions meeting that demand. For each of the regions, historical production-consumption data are presented as well as projected plans for increasing pulp and paper production. The relative advantages of each region with regard to the factors of production and potential demand are pointed up.

Following this treatment of the situation in the regions the prospects for the future are criticized objectively, and the general nature of the difficult problems that must be solved before expansion can take place are indicated.

Taken as a whole, this publication represents a good piece of work; presenting a picture of the world's pulp and paper resources and prospects. The picture is necessarily painted with a broad brush, and this is recognized in the publication which emphasizes the necessity for more intensive investigations to attack specific problems where they exist.

The use of the metric system presents a difficulty to foresters not accustomed to it. Some tables might have been headed more clearly, and a better job of proofreading should have picked up typographical errors in italicization of scientific plant names.

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Woodland Management

By W. E. Hiley. 463 pp. 58 Illus. Faber and Faber Ltd. London. (John de Graff, Inc., New York.) 1954. $12.

Clearly and well written by a prominent British forester, this is a new kind of management book that will be of interest and benefit to American foresters. W. E. Hiley has wide professional experience. He taught for many years at Oxford and is known to many Americans through his books *Economics of Forestry* (1930), *Improvement of Woodlands* (1931), and other writings. His teaching career has been followed by twenty years of practical experience as manager of a large private forestry enterprise.

Woodland Management is based mainly on his own experience. It grew out of a feeling that "academic training was quite inadequate for the needs of practical forestry" and "unquestioning acceptance of traditional methods led to the perpetuation of many wasteful and extravagant practices." It is "intended primarily for owners,

agents and head-foresters who have charge of private woodlands."

The author is conscious of the practical realities of forest management, and achieves an effective integration of economics and silviculture with the necessities of running a paying business. To use an American comparison, the book is what one might expect from an outstanding forester who has long studied and worked in New England, knows the region intimately, and wants to set down and pass on a lifetime of knowledge and experience.

In specific content it is definitely British, dealing intimately with the problems and needs of British forest owners. It includes a large amount of factual information on costs, returns, procedures, and general operating conditions. As such it gives a concrete picture and understanding of forest practice in England. By analogy, much of what is said applies almost any place where woodlands are managed.

Subject matter coverage is wide, but largely centers on plantations since most timber stands actively managed in Britain are of artificial origin. The book includes substantial presentation of growth, yield, and general mensurational information, forest business organization and administration, cutting and log transportation, applied silviculture emphasizing plantation establishment and thinning, marketing, taxation, regulation of the yield, and working plans.

It takes some adjustment for an American reader to become accustomed to British measurements and terminology. For example, tree and log diameters are given in quarter-girth (one-fourth the circumference and volumes in hoppus feet, an arbitrary measure something like a cross between Doyle rule and cubic feet.

The book is a little hard to appraise. It is not intended as a systematic and thorough development of principles and theory as would be expected in a textbook, yet a large amount of such material is included more or less piecemeal and in greater or less concentration. One sometimes wonders whether to read for information or for principles or in what proportion. In some places much precise local detail is given and in others the treatment is rather general. The basic problem in writing a practice book is what to include and what to exclude. In a complex matter like forest management in a country or a large region, the detail of practice and concerns of forest managers are almost endless. Yet a competent treatment of forest management, such as is certainly given here, necessarily must integrate theory, practice, and much solid information. There is need to bring formal forestry education closer to and in harmony with the realities of practice and at the same time to recognize that basic principles and approaches are a great simplifier of and aid to practice; they are facets of the same thing. Mr. Hiley's book should contribute to bringing theory and practice together and in promoting a better understanding of their mutually beneficial interaction.

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The Catoosa Wildlife Management Area

34 pp. Illus. Tennessee Game and Fish Commission, Nashville, Tenn. 1954. Free.

The Tennessee Game and Fish Commission published this attractive booklet with the cooperation of TVA and the Tennessee Division of Forestry. It gives the history, physical description, administrative set-up, timber inventory, and 10-year timber management plan for a 78,000-acre, state-owned area. While the timber management plan, which includes objectives, policies, proposed operations, harvesting quotas, cutting guide, etc., is the basic feature of the report, recreational uses are also discussed.

Plans for wildlife management are broadly expressed. Detailed plans will follow in a later publication.

The concept of multiple-use was dominant in the preparation of this report. Ultimate goal for the area is maximum wildlife production, but sustained timber yield is to be given every consideration consistent with that goal. Watershed protection is reckoned with in timber cutting practices and control over logging methods. The immediately allowable annual cut is 4 million board feet, rising ultimately to 15 million a year with a products value estimated at $1 million.

The publication should be of interest to all those who manage public lands.

C. C. FREEBURN
Pennsylvania Game Commission

Publications of Interest

To aid small timber owners in reporting income from woods operations on their federal income tax returns, the U. S. Department of Agriculture has issued an 8-page leaflet entitled *Federal Income Tax Tips for the Small Timber Owner.*

The leaflet, prepared by Ellis T. Williams of the Division of Forest Economics Research of the Forest Service, points out that many small woodland owners may pay a larger federal income tax than the law requires. Some fail to make a deduction for the cost or other investment in the timber harvested. Others do not realize that receipts from sales of timber and forest products can frequently be reported as capital gain rather than as ordinary income.

The leaflet contains five examples of typical income tax situations. A free copy may be obtained from the Forest Service, U. S. Department of Agriculture, Washington 25, D. C.

Current Literature

Compiled by MARTHA MEELIG, *Librarian, State University of New York College of Forestry*

Range Management Section Compiled by FRANCES FLICK, *Library, U. S. Department of Agriculture*

General

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E. L. DEMMON

Several members have raised questions with me concerning our Code of Ethics, how it benefits members, how often cases involving unprofessional conduct are referred to Society officers, what procedures are followed, etc. Such questions are all rather fully covered in our Constitution (Article IV, Section 5; Article VII, Section 3) and By-Laws (Nos. 23-31, 33).

The Society from its earliest days has considered the maintenance of high professional standards as one of its obligations. In fact, the success of our profession depends on upholding such standards. The organizers of our Society had this in mind when they adopted the first Constitution, which included a section as follows:

> Charges of conduct unbecoming a member may be preferred by any Active member. Such charges shall be made in writing to the Committee on Admissions, which shall without delay investigate them and report to the Society. A two-thirds vote of the Active members shall be necessary to suspend or expel.

The formulation of a Foresters' Code of Ethics, to serve as a guide to professional conduct, was considered by several Councils, and a special committee finally drew up such a code, based in part on the Engineers' Code. This was adopted by the Society in 1948, thus reaffirming and publicizing the professional ideals of American forestry. This written code is still relatively new and is being tested from time to time. Later on, if changes seem desirable they will be considered and acted upon. Copies of the Code suitable for framing are available from the Society's Washington office, and many Society members have them displayed in their offices, as visual evidence of the high ideals of the profession.

It is a satisfaction to foresters to know that charges of unprofessional conduct have been exceedingly rare. Only in a few instances have alleged breaches been brought to the attention of Society officers, and in only a very few cases has it been necessary to invoke disciplinary action. This is indeed a fine tribute to the character of the Society's past leadership and to the exceptional class of men entering the profession.

Every Society member should be familiar with our Code of Ethics and use it as a guide to professional conduct. The schools should bring the Code to the attention of all forestry students before they leave school, as a part of their required training. Every Society member should feel it an ob-

SCHOOL BOX SCORE
1955 MEMBERSHIP

School	Student applications received: April 1955	Eligibles[1] 1955	Total 1955
Alabama Polytechnic Institute	0	27	18
University of California	0	46	15
Colorado A & M College	0	63	3
Duke University	1	11	2
University of Florida	2	22	4
University of Georgia	6	65	20
University of Idaho	1	31	2
Iowa State College	2	65	10
Louisiana Polytechnic Institute	3	19	3
Louisiana State University	0	41	14
University of Maine	0	56	13
University of Massachusetts	1	38	8
Michigan State College	2	60	33
University of Michigan	2	46	14
University of Minnesota	0	40	7
University of Missouri	0	32	8
Montana State University	7	98	17
State University of New York	3	99	20
North Carolina State College	0	59	20
Oregon State College	1	81	9
Pennsylvania State University	2	104	33
Purdue University	0	51	24
Utah State Agricultural College	0	28	7
University of Washington	1	88	27
West Virginia University	1	29	6
Yale University	1	29	16
Totals	36	1,328	353

[1]Includes Juniors and Seniors who will be eligible for Junior Membership upon graduation and graduate students in approved curricula who are not eligible for Junior Membership.

SECTION BOX SCORE
1955 MEMBERSHIP

Section	Applications received[1]: April 1955	Total 1954	Total 1955
Allegheny	3	68	41
Appalachian	2	48	27
Central Rocky Mountain	0	26	4
Central States	0	80	68
Columbia River	15	56	33
Gulf States	7	57	43
Inland Empire	1	39	3
Intermountain	0	14	9
Kentucky-Tennessee	2	5	3
New England	3	54	42
New York	5	40	26
Northern California	2	34	24
Northern Rocky Mountain	10	35	25
Ozark	2	49	18
Puget Sound	3	61	36
Southeastern	8	128	52
Southern California	0	2	3
Southwestern	3	7	5
Upper-Mississippi Valley	3	64	21
Washington	0	7	2
Wisconsin-Michigan	4	11	11
Totals	73	885	496

[1]Student, Junior, Affiliate, Associate (initial) grades only.

ligation to expose violations of the Code. This does not mean that every minor deviation should be brought to the attention of the Society's Committee on Ethics. Many of these matters can be handled at the local level by merely calling attention to alleged infractions. This should be done on a constructive basis and not involve petty or personal motives. Should action by the Council finally become necessary, this group serves as the representative of the Society and acts for the good of the profession.

In the past few years the Council has received a few cases of alleged breach of the Code without publicity. I can assure you that your officers are continually on guard to maintain high ethical standards of the profession for the protection of our members and in the public interest. Foresters are a body of trained specialists who are all working for the common good and we want to continue to maintain the high general esteem in which we are held by the public.

E. L. Demmon

Second Call for Council Nominations

The regular biennial election will be held December 3, 1955. A president, vice president, and nine other members of the Council will be elected for the two-year term 1956-1957.

The present Council is listed in the box on page 296. Any or all of these incumbents may be renominated, provided they accept the nomination in writing.

President Demmon has announced that he will not be a candidate for reelection.

Membership on the Council is restricted by the Constitution to Members (formerly Senior Members) and Fellows. Any Member or Fellow is eligible to hold office who is in good standing and who accepts the nomination in writing and declares his willingness to serve if elected.

Each voter will have an opportunity to ballot on all candidates for office. Council members are elected in accordance with the system of proportional representation. The procedure will be explained in a later issue of the JOURNAL. It is the system by which the Society has been electing Council members for over two decades. Candidates for the office of president are voted on separately; the candidate who receives the highest vote is declared elected president, and the candidate who receives the next highest vote is declared elected vice president.

How Nominations Are Made

The Constitution (Article VIII, Section 2) states the conditions under which nominations are made by petition.

1. Each petition shall name but one candidate.

2. All candidates must be eligible to hold elective office.

3. A petition shall bear the signatures of at least ten voting members who at the time of signing the petition are eligible to vote in the coming election. (Eligible voting members are Junior Members, Members, and Fellows in good standing.)

4. A voting member may not sign more than one nominating petition for

President or more than one nominating petition for a member of the Council. That is, he may sign two, but no more.

5. Petitions must be in the Society office by October 1, 1955.

The Society has no special form for submitting nominating petitions. They may be written as follows:

We, the undersigned voting members of the Society of American Foresters, hereby nominate John Doe, a Member (or Fellow) for the office of president (or member of the Council) for the two-year term 1956-1957.

All nominating petitions should be sent promptly to the Society office. The executive secretary will gladly provide information about nominating or election procedure.

According to the Constitution (Article VIII, Section 1) a Nominating Committee has been appointed by President Demmon. The Committee is composed of the following members:

Chairman, Adna R. Bond, Arnold, Maryland.

Randolph M. Brown, School of Forestry, University Farm, St. Paul 1, Minn.

Robert H. Clark, 209 West College, Fordyce, Ark.

Milo Deming, U. S. Bureau of Land Management, P. O. Box 659, Salt Lake City, Utah.

Edwin Loners, 3229 Alki Avenue, Seattle 6, Wash.

This committee has set the date of the election for December 3, 1955.

There must be at least two candidates for the office of president, and at least nine candidates for membership on the Council. However, the Nominating Committee has announced that it will make no nominations of its own unless the voting membership fails to make the required minimum number of nominations by petition. Voting members should accordingly get busy and make their own nominations.

Nominations Received

Up to the time of going to press, the following nominations had been received.

For the Council. B. E. Allen, Union Bag and Paper Company, Savannah, Ga. (Southeastern Section).

Plan Now to
Attend Annual Meeting
Portland, Oregon
Hotel Multnomah
October 16-19, 1955

Second Call for Fellow Nominations

All Members (formerly Senior Members) and Fellows of the Society are hereby advised that nominations for the grade of Fellow are now open. The election of Fellows will be held at the time of the Society's regular biennial election, December 3, 1955.

As defined by the Constitution (Article III, Section 6), "Fellows shall be foresters of outstanding achievement as leaders in responsible directive or distinctive individual work of a fruitful character. They shall be elected from the Members and shall be engaged in forestry work at the time of their election."

Nominations by Petition

The procedure for placing Members in nomination for the grade of Fellow is by petition. The Society has no printed form for this purpose; the petition may be typewritten thus:

We, the undersigned Members and Fellows of the Society of American Foresters, hereby nominate _____ for election to the grade of Fellow in 1955.

Remember these simple rules:

1. A petition may not name more than one candidate.

2. It must be signed by 25 Members or Fellows in good standing.

3. It should be accompanied by a factual, not eulogistic, biographical sketch of at least 200 words giving an account of the nominee's professional career and accomplishments.

4. It must be received in the executive office of the Society in Washington, D. C., not later than October 1, 1955.

The executive employees of the Society cannot be responsible for obtaining signatures on partially completed petitions or on petitions incomplete by reason of unacceptable signatures (that is, signatures of other than Members and Fellows in good standing).

Nominations Received

Up to the time of going to press, the following nominations had been received.

Samuel B. Detwiler. Boulder, Colo.

Election Procedure

Fellows are not elected by the membership at large, but by a board of electors which consists of all present Fellows and the present Council. (A Council member who is also a Fellow has but one vote.)

The system is described in Article IV, Section 4 of the Constitution. To win election a candidate must receive an affirmative vote of not less than one-half the total votes cast.

Significance of the Grade

The highest membership distinction that can be conferred by the Society, this grade is awarded in recognition of outstanding achievement. Fellows do not pay increased dues; their dues are the same as those of Members.

Since the Society was founded in 1900, there have been 100 Fellows elected. At the present time the number of living Fellows is 69.

Since the last election in December 1953, two Fellows have died: Elers Koch and E. A. Sterling.

List of Fellows

The current roster of Fellows follows. The state in which each Fellow is domiciled and the year of his election are shown after his name.

Allen, Shirley W. Michigan. 1948.

Baker, Frederick S. California. 1949.
Besley, Fred W. Maryland. 1940.
Brundage, Frederick H. Oregon. 1949.
Butler, Ovid. Maryland. 1940.

Carter, E. E. District of Columbia. 1942.
Chapman, Herman H. Connecticut. 1922.
Clapp, Earle H. District of Columbia. 1930.
Clepper, Henry E. Virginia. 1949.
Coffman, John D. California. 1946.
Cox, William T. Minnesota. 1953.
Curran, Hugh. Venezuela. 1951.

Damtoft, Walter J. North Carolina. 1951.
Dana, Samuel T. Michigan. 1935.
Demmon, Elwood L. North Carolina. 1951.
Drake, George L. Washington. 1953.

Eldredge, Inman F. Louisiana. 1942.
Evans, Charles F. Georgia. 1949.
Evenden, J. C. Idaho. 1953.

Ferguson, J. A. Pennsylvania. 1949.
Fischer, Arthur F. California. 1940.
Fritz, Emanuel. California. 1951.
Frothingham, E. H. California. 1942.

Garratt, George A. Connecticut. 1953.
Gill, Tom. District of Columbia. 1948.
Granger, Christopher M. Maryland. 1946.
Greeley, William B. Washington. 1918.
Guise, Cedric H. New York. 1951.
Guthrie, John D. Virginia. 1942.

Hall, William L. Arkansas. 1940.
Hartley, Carl P. Maryland. 1949.
Hawes, Austin F. Connecticut. 1939.
Hawley, Ralph C. Connecticut. 1942.
Heintzleman, B. Frank. Alaska. 1951.
Holmes, J. S. North Carolina. 1939.
Hosmer, Ralph S. New York. 1932.
Hunt, George M. Wisconsin. 1951.

Illick, Joseph S. New York. 1946.
Isaac, Leo A. Oregon. 1953.

Jeffers, Dwight S. Oregon. 1948.

FORESTERS WANTED!

Inspecting a standing utility pole prior to treatment.

Applications are now being accepted for permanent Foreman positions outlined as follows:

- **NATURE OF WORK** — From April through November most Foremen are occupied with the groundline inspection and preservative treatment of standing telephone and power poles. The Working Foreman is in charge of crews averaging 3-5 men.

  From December through March Foremen operate right of way brush control crews performing selective, basal spraying for utility companies.

- **REMUNERATION** — After a period of on-the-job training that varies with individual capabilities, Foremen can expect to average in excess of one hundred dollars weekly in pole inspection work.

- **LOCATION** — Foremen may be assigned anywhere in the northern section of the Middle west and East.

- **GENERAL QUALIFICATIONS** — Forestry school graduates receive preference. New men can expect to move from place to place every few months. Applicants should be between the ages of 22-35 and state draft status at time of application.

Write or Wire: Utilities Division

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Kelley, E. W. California. 1949.
Kellogg, Royal S. Florida. 1949.
Kinney, Jay P. New York. 1942.
Kittredge, Joseph. California. 1953.
Korstian, Clarence F. North Carolina. 1942.
Krueger, Myron E. California. 1951.

Lowdermilk, Walter C. California. 1948.

MacDonald, G. B. Iowa. 1944.
Marsh, Raymond E. District of Columbia. 1948.
Martin, Clyde S. Washington. 1948.
Mason, David T. Oregon. 1948.
McArdle, Richard E. District of Columbia. 1953.
Metcalf, Woodbridge. California. 1953.
Morrell, Fred W. Virginia. 1951.
Mulford, Walter. California. 1939.
Munger, Thornton T. Oregon. 1946.
Munns, Edward N. California. 1949.

Preston, John F. District of Columbia. 1948.
Price, Jay H. Arizona. 1951.

Schmitz, Henry. Washington. 1940.
Shirley, Hardy L. New York. 1951.
Show, S. B. California. 1948.
Siecke, E. O. Texas. 1946.
Sparhawk, William N. New Hampshire. 1946.

Watts, Lyle F. Oregon. 1946.
Winslow, C. P. Washington. 1942.
Wirt, George H. Pennsylvania. 1948.

Ziegler, E. A. Pennsylvania. 1949.
Zon, Raphael. Minnesota. 1918.

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Record Year Changed

To reduce peak work loads thereby promoting efficiency, the record year, effective 1955, will end December 31st instead of November 30th. The fiscal year remains the same, ending November 30th. Billing date for the ensuing year's dues will be December 1.

Hereafter, Section membership lists, run on 3x5 cards, Section membership counts, and membership by grades will be made as of June 30th and December 31st.

Division of Silviculture Calls for Meeting Papers

The Division of Silviculture is currently organizing its program for the 1955 meeting of the Society at Portland, Oregon, October 16-19. As in previous meetings, it is planned to devote one-half day to contributed papers and one-half day to a panel discussion with invited speakers.

This is the call for titles of papers from which the committee will make up the half-day program devoted to contributed papers. The general theme of the annual meeting will be "Converting the Old Growth Forest." However, papers on any phase of silviculture from any part of the country are eligible, and encouraged, for the program.

Papers should be limited to twenty minutes reading time, by actual test, including the time required to explain slides or charts, if used. Slides should be standard 2 by 2 size.

Titles, along with short abstracts of what the paper will include, should be submitted to the chairman of the Division, John W. Duffield, 1472 Eskridge Way, Olympia, Washington, by April 16. Please indicate whether a slide projector or other equipment will be needed.

GEORGE R. STAEBLER
Secretary, Division of Silviculture

Ozark Section Holds Meeting

The annual winter meeting of the Ozark Section was held February 4 and 5 in south Arkansas with El Dorado the host city. The first day was spent at Crossett with visits to the lumber and paper mills of the Crossett Industries. A planned field trip on the Crossett Experimental Forest of the Southern Forest Experiment Station had to be called off for the most part because of inclement weather. A social hour at the Randolph Hotel was sponsored by various timber industries of south Arkansas. A banquet was held in the Garrett Hotel with J. H. Rowland of the Reynolds Aluminum Company as guest speaker.

An indoor meeting was held during the morning of February 5. Custer Ross of the Arkansas Forestry Commission spoke on fire organization in his district. Don Tufts of the Crossett Forestry Division gave an illustrated lecture on "Sawmill De-barkers and Chippers." John Crafton of the Chipcraft Company spoke on "Use of Wood Waste" and showed a short movie of his company's operations. Winston Purifoy of the Crossett Lumber Company Sales Division discussed "The Wood and Sawmill Business of the Future."

During the business meeting the various outstanding committees gave their reports. It was voted hereafter to have Section officers assume duties on July 1, the present officers to remain in office until June 30.

New officers elected were Gordon Hartrick of Fountain Hill, Ark., as chairman. Other officers were John Burwell, Broken Bow, Okla., vice chair-

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man; and Nelson Rogers of Salem, Mo., secretary-treasurer.

Committee for the Advancement of Forestry Education

The Division of Education passed the following motion at Milwaukee on October 25, 1954.

Moved, that the following quoted motion which was passed by the Division of Education at the Annual Meeting of the Society of American Foresters in 1951, be again submitted to the Council for consideration: "The Division of Education recommends to the Council that the present Committee on Accrediting be reconstituted as a Committee for the Advancement of Forestry Education. This committee shall continue its accrediting functions for undergraduate programs. In addition it should study training at the graduate level and present its findings and recommendations to the Division for consideration. This reconstitution is in recognition of the large contribution the Committee on Accrediting has made toward the advancement of forestry education and its broadening scope."

Dr. Myron Krueger, chairman of the Committee on Accrediting, commented on this proposal as follows:

One strong reason for reconstituting the Committee on Accrediting is that this committee keeps itself better informed on forestry education in general than any other committee of the Society. Then too, the designation "Committee for the Advancement of Forestry Education" might make its work much more acceptable by the regional education associations with which we are now cooperating.

In effect what I am saying is this: The Society should have some committee definitely charged with the responsibility of bringing about continuous improvement in forestry education. It is my belief that the same committee which is charged with the responsibility of examining forestry curricula for accreditation purposes is probably in the best position to perform the function of bringing about improvement in forestry education. I feel somewhat freer in making this statement because of my intention of resigning as a member of the Committee as of December 31, 1955.

By letter ballot the Council has unanimously approved the proposal.

Appalachian Section Annual Meeting

For the first time in the memory of members of the Appalachian Section, Society of American Foresters, the program of an annual meeting was devoted to informational and educational techniques of meeting forestry problems and bringing the forestry "story" to the public. Nearly 200 foresters from Virginia, North Carolina, and South Carolina met January 21-22 at Columbia, S. C., to attend this meeting.

State Forester C. H. Flory of Columbia served as program chairman. Clint Davis of Washington, D. C., director of the Cooperative Forest Fire Prevention Program, spoke on "Nationwide Fire Occurrence," and assistant state forester J. R. Tiller of the S. C. State Commission of Forestry spoke on "Statewide Fire Occurrence." Vern Cutler, forester for Argent Lumber Company of Hardeeville, S. C., talked on "Fire Occurrence at the Forks of the Creek." H. J. Malsberger of the Southern Pulpwood Conservation Association of Atlanta spoke on "The Development of Public Understanding of the Pulp and Paper Industry in the South." Tom V. Downing, assistant state supervisor of Vocational Agriculture, State Board of Education, Richmond, Va., spoke on "Creating Conservation Concepts Among Teachers." R. J. Preston, director, Division of Forestry of N. C. State College of Raleigh, spoke on "Selling the Career of Forestry to High School Students."

Elected chairman of the Appalachian Section was Tom Lotti, Officer in Charge of the Santee Research Center of the U. S. Forest Service at Charleston, S. C. Peter Lannan of Georgetown, S. C., research forester for West Virginia Pulp & Paper Company, was elected vice chairman. C. H. Stoltenberg, professor of forest economics at Duke University in Durham, N. C. was chosen the Section's secretary-treasurer, and G. F. Gruschow of the Southeastern Forest Experiment Station Research Center at Franklin, Va. was elected executive committeeman.

WALTER T. AHEARN

New York Section Holds Winter Meeting

The annual winter meeting of the New York Section was held at the Onondaga Hotel, Syracuse, on January 20-21, 1955. Chairman Allen W. Bratton opened the sessions with the business meeting. Contrary to past practice, the business meeting was held before, rather than following, the regular meeting sessions. It was heartening to note that over three times the usual number of people attended the business session. Whether this was by accident, or not, the program planning committees of the future should take note of the results of this meeting arrangement.

C. E. Farnsworth acted as chairman for the first session of the regular part of the meeting. Mr. A. G. Johnson, research fellow from the Cabot Foundation at Jamaica Plains, Mass., presented the opening paper entitled "The Objectives of Forest Tree Breeding." Following this D. S. Welch of Cornell spoke on "Tree Breeding as Related to the Chestnut Blight." In comment-

ing on this paper, a welcome visitor from Michigan State College, Prof. Paul A. Herbert, related some of his own experiences in connection with chestnut breeding. Ray R. Hirt from Syracuse spoke next on "Breeding Tests in White Pine as Related to Blister-Rust." Ray Hansbrough, in commenting on Hirt's paper, was by no means a stranger to the New York Section and contributed much to the meeting in his discussions relative to white pine. David B. Cook, gave an enlightening talk on the "Improvement of Larch by Selection of Species and Geographic Races." E. W. Littlefield closed the afternoon session with his paper "Growing Douglas-Fir in New York." Ray Benson and J. D. Kennedy commented on the last two papers of the afternoon session.

A fine banquet of roast beef was held in the Ball Room of the Onondaga Hotel, at which an array of door prizes from D. B. Smith Co. were given to the holders of lucky numbers. Dean Hardy Shirley gave an illustrated talk on the Fourth World Forestry Congress, recently held in India.

E. W. Littlefield acted as chairman for the Friday morning sessions. E. J. Eliason's paper "Seed Collecting in New York" was first on the agenda, followed by an illustrated talk by E. J. Schreiner of the Northeastern Forest Experiment Station entitled "Tree Breeding in Europe." C. E. Farnsworth spoke next on "Genetics, Tree Improvement and Silviculture;" and in closing the sessions, a talk "Forest Tree Improvement—A Summary" was given by A. B. Recknagel.

Following this, Chairman Bratton reopened the business meeting at which time the resolutions chairman, Cedric Guise, presented the remaining resolutions and the meeting was adjourned in a spirit of much-a-do about this new business of forest genetics and improvement breeding.

Membership Applications and Advancements

Proposals for admission, advancement, and reinstatement received in the Society office during the month of February are listed below. Action on the eligibility of those proposed for membership as listed below will be taken by the Council as of May 1, 1955. Communications from voting members regarding the membership eligibility of these persons should be received in the Society office prior to that date.

Allegheny Section

Student Grade

PENNSYLVANIA STATE UNIVERSITY

Cowan, R. L. Hough, W. A.

WEST VIRGINIA UNIVERSITY

Kautz, W. W.

Comparison of MUSSER seedling (at right of picture) with an ordinary seedling.

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Good heredity, careful selection of seed and scientific culture in the nursery assure superior stock. **Heavy Roots — Sturdy Tops,** assure rapid growth.

SEEDLINGS AND TRANSPLANTS AT LOW QUANTITY PRICE

50 at 100 rate		Per 100	Per 1000
• **SCOTCH PINE** — *Special Strain* Very best Christmas tree strain. From seed collected by our own men from selected parent trees. Exceptionally healthy, sturdy, straight-stemmed, rich color.			
2-yr. S.	4-8"	$ 5.00	$25.00
2-yr. S.	5-10"	7.00	35.00
• **AUSTRIAN PINE** — *Ornamental and Christmas tree.*			
2-yr. S.	3-6"	$ 5.00	$25.00
3-yr. S.	6-12"	7.00	35.00
• **MUGHO PINE** — *True Dwarf* Compact, low-growing Ornamental Pine.			
3-yr. S.	4-6"	$ 7.00	$35.00
5-yr. T.	6-12"	16.00	80.00
• **NORWAY SPRUCE** From seed collected by our own men from selected trees. Exceptionally fast growing, straight-stemmed, especially desirable for Christmas trees, ornamentals and timber.			
3-yr. S.	10-14"	$10.00	$50.00
5-yr. T.	10-16"	25.00	.....
• **BLUE SPRUCE** — *Excellent stock — finest in the country.*			
2-yr. S.	3-6"	$ 7.00	$35.00
3-yr. S.	5-10"	12.00	60.00
4-yr. T.	6-10"	30.00	150.00
• **DOUGLAS FIR** — *Hardy Rocky Mountain type.* Superior Ornamental and Christmas tree.			
2-yr. S.	4-8"	$ 8.00	$40.00
3-yr. S.	8-12"	14.00	70.00
• **CONCOLOR FIR** — *Excellent Ornamental.* Silver trunk, soft silver foliage. One of the best Christmas trees. Holds needles best of any short-needled tree.			
2-yr. S.	5-10"	$12.00	$60.00
3-yr. S.	8-14"	17.00	85.00

500 at 1000 rate		Per 100	Per 1000
• **PYRAMIDAL ARBORVITAE** — *Transplants* All plants started from rooted cuttings to assure true strains.			
1-yr. T.	4-6"	$25.00	$200.00
2-yr. T.	10-16"	40.00	350.00
Extra-heavy stems. Very nice plants.			
• **JUNIPER** — *Blue Pfitzer* This improved Juniper with its irregular spreading habit, fast growth, and bluish color can be used extensively in landscape work. Preferred by many for foundation plantings.			
1-yr. T.	6-8"	$25.00	$200.00
2-yr. T.	6-10"	65.00	.....
3-yr. T.	10-15"	90.00	.....
• **BARBERRY** — *Unusually good red color.* Excellent hedge plants. Red leaves in summer; red berries in fall and winter.			
2-yr. S.	4-10"	$10.00	$ 50.00
3-yr. S.	8-15"	16.00	80.00
• **NORWAY MAPLE** — *Shade Tree.*			
1-yr. S.	6-10"	$ 8.00	$ 40.00
2-yr. S.	10-15"	14.00	70.00
3-yr. S.	20-36"	75.00	.....
• **WHITE BIRCH**			
Seedlings	16-24"	$10.00	$ 50.00
1-yr. T.	24-30"	25.00	.....
• **LILACS** — *Common purple lilac.*			
1-yr. S.	6-12"	$ 5.00	$ 45.00
2-yr. S.	10-18"	10.00	80.00
• **WHITE DOGWOOD**			
1-yr. S.	5-8"	$ 9.00	$ 45.00
2-yr. S.	16-24"	18.00	90.00
• **ROSA MULTIFLORA** For living fence and wild-life shelter and food. Graded 3 mm and up			
10-18"		$10.00	$ 50.00

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Emig, C. W. — Yehl, R. K.

WEST VIRGINIA UNIVERSITY

Deitz, J. E. — Swank, G. W.
Neal, J. W. — Wimer, J. W.
Rogers, B. B.

Appalachian Section

Student Grade

DUKE UNIVERSITY

Douglas, C. R.

Junior Grade

Keppler, W. E., Beaver Rd., Rt. 1, Asheville, N. C. Reinstatement.

Ledford, R. H., Forester, Witherbee Ranger Dist., Moncks Corner, S. C.; Duke, M.F., 1952.

DUKE UNIVERSITY

Students Eligible for Automatic Advancement

White, F. M. — Worst, R. H.

Central Rocky Mountain Section

Junior Grade

COLORADO A & M COLLEGE

Students Eligible for Automatic Advancement

Scott, J. B.

Member Grade

Lyons, R. D., Read Feather Lakes, Colorado. Reinstatement.

Central States Section

Junior Grade

Massie, G. E., 1102 Grand Ave., Beardstown, Ill. Reinstatement.

PURDUE UNIVERSITY

Students Eligible for Automatic Advancement

Klemeyer, J. L. — Weber, J. T.

Member Grade

Beadell, H. A., 3953 N. New Jersey, Indianapolis, Ind. Reinstatement.

Brede, W. F., Joseph E. Seagram & Sons, Inc., Lawrenceburg, Ind. (Junior, 1948).

Columbia River Section

Student Grade

OREGON STATE COLLEGE

Kirkmire, N. J.

Junior Grade

Douglass, B. S., Forester, U.S.F.S., Seneca, Ore.; U. of Wash.; B.S.F., 1941.

Foster, B. B., Forester, Bureau of Indian Affairs, Klamath Agency, Ore.; Colo. A & M, B.S.F., 1952.

Gross, W. E., Dist. Ranger, U.S.F.S., Bly, Ore. Reinstatement.

Lorts, J. O., Forester, Bureau of Land Mgmt., Eugene, Ore.; Univ. of Idaho, B.S.F., 1952.

Peacock, C. E., Forester, U.S.F.S., Sisters, Ore.; Montana State, B.S.F., 1949.

Peterson, H. A., Asst. Logging Eng., Santiam Lbr. Co., Sweet Home, Ore.; Ore. State, B.S.F., 1954.

Pryor, D. R., Forester, Bureau of Land Mgmt., Medford, Ore. Reinstatement.

Sankela, W. E., Forester, Bureau of Land Mgmt., Portland, Ore. Reinstatement.

Saubert, J. D., Dist. Ranger, U.S.F.S., Foster, Ore.; Oregon State, B.S.F., 1935.

Sharrer, G. H., Supv., Bureau of Land Mgmt., Beaverton, Ore.; Univ. of Calif., B.S.F., 1939.

Sheldon, J. G., Salvage Foreman, Star Rt., Castle Rock, Wash.; Univ. of Wash., B.S.F., 1953.

Shelland, C. D., Forester, U. S. Indian Service, Klamath Agency, Ore.; Purdue, B.S.F., 1948.

Steenbergen, J. T., Box 1067, Brookings, Ore. Reinstatement.

Wiener, A. A., Forester, U.S.F.S., Eugene, Ore. Reinstatement.

Member Grade

Krueger, O. C. F., 110 Cherry Dr., Eugene, Ore. (Junior, 31R55).

Affiliate Grade

Conklin, T. D., Forester, Bureau of Land Mgmt., Portland, Ore.

Gilden, E. E., County Extension Agent, State of Ore., Roseburg, Ore.; Wash. State, B.S., (Forestry), 1947.

Hansen, C. S., Forester, Bureau of Land Mgmt., Portland, Ore.

Sturges, L. W., Forester, Lovegren Lbr. Co., Eugene, Ore.; Oregon State, B.S., (Forestry), 1948.

Tachanz, D. B., Forester, Bureau of Indian Affairs, Warm Springs, Ore.; Univ. of Idaho, B.S., (Rge. Mgmt.), 1951.

Gulf States Section

Student Grade

LOUISIANA POLYTECHNIC INSTITUTE

Essmeier, D. L. — Mattin, J. H.
McCasland, R. K.

Junior Grade

Edgette, E. A., Forester, U.S.F.S., Holly Springs, Miss.; Univ. of Mich., B.S.F., 1950.

Guerrero, W. A., Proj. Forester, U.S.F.S., Riplet, Miss.; Pa. State, B.S.F., 1951.

LOUISIANA STATE UNIVERSITY

Students Eligible for Automatic Advancement

Ladner, B. J.

Member Grade

Smith, M. R., Box 657, Olla, La. Reinstatement.

Affiliate Grade

Griffith, W. H., Land Agent, Tensas Delta Land Co., Monroe, La.

Associate Grade

Carter, T. L., Partner, W. T. Carter & Bro., Camden, Texas.

Inland Empire Section

Student Grade

UNIVERSITY OF IDAHO

Kizer, R. D.

Junior Grade

Huffman, P. W., 1309 Maple St., Clarkston, Wash. Reinstatement.

Nousianen, A. O., Grangeville, Idaho. Reinstatement.

UNIVERSITY OF IDAHO

Students Eligible for Automatic Advancement

Almas, D. P. — Goddard, W. D.
Dudley, R. R.

Member Grade

Klehm, K. A., Forest Supv., U.S.F.S., Sandpoint, Idaho. Reinstatement.

Kentucky-Tennessee Section

Junior Grade

Beavers, J. T., Asst. Forester, Univ. of Tenn., Harriman, Tenn.; Univ. of the South, B.S., (Forestry), 1948. (Affiliate, 1953).

Shreve, L. W., Service Forester, Ky. Div. of Forestry, Mayfield, Ky.; W. Va. Univ., B.S.F., 1951.

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YALE UNIVERSITY

Peters, J. E.

Junior Grade

Chitty, M. L., 182 N. Fourth St., Old Town, Maine. Reinstatement.

Plumb, A. W., Resident Forester, New England Forestry Foundation, Inc., Boston, Mass. (Affiliate, 1951).

UNIVERSITY OF MAINE

Students Eligible for Automatic Advancement

Carl, C. M. — Rule, W. W.
Dyer, H. L.

Affiliate Grade

Post, A. H., Box 43, Spofford, N. H. Reinstatement.

Soulia, J. R., Draftsman, M. H. Rhodes, Inc., Plainville, Conn.; Univ. of Conn., B.S., (Forestry), 1950.

New York Section

Student Grade

STATE UNIVERSITY OF NEW YORK

Frank, E. C. — Namkoong, G.
Hovey, S. T.

Junior Grade

Carota, N., Foreman, Tully Forest, Tully, N. Y.; Mich. State, B.S.F., 1950.

Madison, H., 312 Division St., Northville, N. Y. Reinstatement.

Associate Grade

Crossman, R. F., Dean of Students, State Univ. of N. Y., Syracuse, N. Y.; Syracuse Univ., M.A., (English), 1930.

Northern California Section

Junior Grade

Hastings, L. C., Box 1591, Redding, Calif. Reinstatement.

UNIVERSITY OF CALIFORNIA

Students Eligible for Automatic Advancement

Atkinson, W. A. — Gardner, R. W.
Day, R. J.

Member Grade

Ramstad, G. I., U.S.F.S., Georgetown, Calif. Reinstatement.

Schreiber, R. P., Sequoia Natl. Park, Three Rivers, Calif. Reinstatement.

Affiliate Grade

Friberg, L. C., Foreman, Calif. Div. of Forestry, Redding, Calif.

Mitchell, H. L., B.R.C. Officer, U.S.F.S., Fresno, Calif; Ore. State, B.S., (Entomology), 1950.

Northern Rocky Mountain Section

Student Grade

MONTANA STATE UNIVERSITY

Addor, E. E. — Moore, H. R.
Burrows, G. L. — Olson, R. H.
Duhamel, E. E. — Poulson, W. L.
Hautzinger, J. L.

Junior Grade

Contes, A. B., Stan-Craft Apt., Polson, Mont. Reinstatement.

Heisel, E. A., Dispatch Clerk, J. Neils Lbr. Co., Libby, Mont.; Mont. State, B.S.F., 1949.

McBride, J. K., Forester, J. Neils Lbr. Co., Libby, Mont.; Univ. of Maine, B.S.F., 1952.

Paarfusser, A. F., Clerk, J. Neils Lbr. Co., Libby, Mont.; Univ. of Mich., B.S.F., 1949.

Ozark Section

Junior Grade

Dodson, R. K., U.S.F.S., Mt. Ida, Ark. Reinstatement.

Elliott, B. F., Forest Ranger, Ava, Mo. Reinstatement.

Schoenike, R. E., Forester, U.S.F.S., Crossett, Ark.; Univ. of Minn., B.S.F., 1951.

Supola, M. N., Forester, U.S.F.S., Springerville, Reinstatement.

Wheeler, D. H., Dist. Forester, Dierks Forests, Inc., Dierks, Ark.; Mont. State, B.S.F., 1950.

UNIVERSITY OF MISSOURI

Students Eligible for Automatic Advancement

Krugman, S. L. — Puchbauer, F. C.
Mason, D. — Shearer, W. D.
Oonk, G. B. — Woodland, R. W.

Affiliate Grade

Williams, O. L., Box 575, Sheridan, Ark. Reinstatement.

Puget Sound Section

Student Grade

UNIVERSITY OF WASHINGTON

Cohen, L. I.

Junior Grade

Cole, R. M., Forester, U.S.F.S., Randle, Wash. Reinstatement.

Drake, W. E., Dist. Ranger, U.S.F.S., Ellensburg, Wash.; Univ. of Wash., B.S.F., 1939.

UNIVERSITY OF WASHINGTON

Students Eligible for Automatic Advancement

Karlsson, E.

Member Grade

Buckley, J. L., Box 998, College, Alaska. (Junior, 1946).

James, G. A., U.S.F.S., Ketchikan, Alaska. (Junior, 1948).

Affiliate Grade

Haight, C. R., Asst. Dist. Warden, State Div. of Forestry, Yakima, Wash.; Wash. State, B.S., (Forestry), 1949.

Southeastern Section

Student Grade

UNIVERSITY OF FLORIDA

Cocke, R. E. — Stewart, D. P.

UNIVERSITY OF GEORGIA

Baker, R. C. — Roberson, D. P.
Fulghum, C. B. — Seery, D. A.
Morrison, A. A. — Steele, J. L.

Junior Grade

Childs, W. L., 1270 Dudley Ave., Bartow, Fla. Reinstatement.

Griffin, H. J., Box 390, Forsyth, Ga. Reinstatement.

McCullers, A. G., Forester, Fla. Forest Service, Lake City, Fla. Reinstatement.

Parker, E. M., Woodlands Dept., International Paper Co., Panama City, Fla. Reinstatement.

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Member Grade

Bradshaw, D. E., Box 387, Jacksonville Beach, Fla. Reinstatement.

Southern California Section

Junior Grade

Snyder, D. E., 670th AC & W Sq., San Pedro, Calif. Reinstatement.

Southwestern Section

Junior Grade

Supola, M. N., Forester, U.S.F.S., Springerville, Ariz.; Mont. State, B.S.F., 1954.

Affiliate Grade

Cable, D. R., Range Conservationist, U.S.F.S., Tempe, Ariz.; Univ. of Idaho, B.S., (Range Mgmt.), 1938.

Ingersoll, T. R., Forestry Aide, U.S.F.S., Springerville, Ariz.; Univ. of Idaho, B.S., (Range Mgmt.), 1952.

Upper-Mississippi Valley Section

Student Grade

IOWA STATE COLLEGE

Collen, D. A. — DeVaul, F. D.

Junior Grade

Heinz, J. M., Forester, State of Minn., Park Rapids, Minn.; Univ. of Minn., B.S.F., 1951.

Jongewaard, R. V., Foley, Minn. Reinstatement.

Associate Grade

Mayne, H. W., 1479 Hythe Ave., St. Paul, Minn. Reinstatement.

Wisconsin-Michigan Section

Student Grade

MICHIGAN STATE COLLEGE

Ehlen, R. R. — Rappel, D. C.

UNIVERSITY OF MICHIGAN

Hoover, J. T. — Johnson, C. M.

Junior Grade

Baldwin, A. G., Box 24, Black River Falls, Wis. Reinstatement.

Baltus, J. R., 403 N. 10th Ave., Wausau, Wis. Reinstatement.

Peterson, H. S., 1128 Cedar Ave., Iron Mountain, Mich. Reinstatement.

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Forestry News

Superior Paper Made Experimentally from Synthetic Fibers

Paper has been successfully produced for the first time from synthetic fibers, according to the Du Pont Company. It is three to ten times stronger than paper made from the conventional pulp or rags.

The new paper, made experimentally from nylon fiber, "Dacron" polyester fiber, and "Orlon" acrylic fiber, was described at the annual meeting of the Technical Association of the Pulp and Paper Industry at Wilmington, Del.

While tests indicate the synthetic fiber papers can be made commercially, Du Pont will not manufacture them but is making the details of the work available to the paper industry.

Dr. Robert A. A. Hentschel of Du Pont's Pioneering Research Division, Textile Fibers Department, said the unusual properties of synthetic fibers are carried over into the papers made from them. "They are highly resistant to chemical attack, absorb very little moisture, and resist the action of molds, bacteria, and light," he said.

"The high strength of the synthetic fiber papers suggests use in such applications as heavy duty bags, for instance, and their resistance to chemical attack would be useful in filtration of corrosive liquids and packaging chemicals. The stability of the papers to moisture indicates possible use in map and tracing papers and for important records and documents where permanence is necessary," Dr. Hentschel said.

He further disclosed that the resistance of these papers to folding was up to 200 times that of papers made from wood pulp or rags.

Dr. Hentschel said that usual starting methods of making paper were followed in the laboratory work. The fibers were cut in short lengths, slurried with water, and formed into sheets on a wire screen. The sheets were then dried, impregnated with bonding agents, and finally heated and pressed to bond the paper. Bonding agents used were either inorganic salts, such as calcium bromide, or synthetic polymers similar to the fibers being bonded.

The cost of paper from synthetic fibers is higher than wood pulp paper, but Dr. Hentschel pointed out these costs can be expected to decrease as the use of the paper increases.

He concluded that since these papers represent potentially valuable products to diversify further the range of paper properties, technological cooperation between papermakers and fiber producers, like Du Pont, will successfully solve the remaining problems of commercial production.

Dr. Hentschel's summation of the research was jointly prepared by his Du Pont associates, Franklin H. Koontz and Dr. John R. McCartney, and Dr. James K. Hubbard, now of Weyerhaeuser Timber Company.

Northwest Forest Genetics Association Formed

An organizational meeting for a Northwest Forest Genetics Association was held in Portland on February 18. A small organizing group of U. S. and Canadian representatives from industrial, public, and college organizations was called together by R. W. Cowlin, Pacific Northwest Forest and Range Experiment Station, following two public meetings.

Plans were laid for an organizational and field meeting of genetics research workers in the spring. Leo A. Isaac was chosen as temporary chairman. His address is P. O. Box 4059, Portland 8, Ore.

International Arid Lands Meetings

The American Association for the Advancement of Science and the Southwestern and Rocky Mountain Division of the A.A.A.S. are sponsoring International Arid Lands Meetings April 26—May 4, 1955, at Albuquerque and Socorro, New Mexico. The meetings will be conducted with the goal of bringing together people from various sciences with the idea of pooling their ideas and efforts in the solution of scientific and developmental problems of arid zones. The meetings are supported by the National Science Foundation; the Rockefeller Foundation; and the United Nations Educational, Scientific and Cultural Organization.

Dr. Raymond Price will officially represent the Society of American Foresters, but all interested foresters are invited to attend.

Lake States Forest Insect Survey Conference

The annual Lake States Forest Insect Survey Conference with about 40 entomologists and foresters in attendance, representing industry and universities as well as federal and state agencies, was held at the Andrews Hotel, Minneapolis, Minn., on February 3 and 4. H. J. MacAloney, chief of the Division of Forest Insect Research of the Lake States Forest Experiment Station, St. Paul, arranged the program.

The theme for the conference was the development of uniform methods for appraising and reporting the abundance of the more important forest insects in the Lake States Region and the damage caused by them. As a result of the 2-day discussions uniform survey procedures were approved for spruce budworm, jack-pine budworm, larch sawfly, forest tent caterpillar, pine sawflies, and pine tortoise scale. Additional species will be considered at the 1956 conference.

J. L. Bean of the Lake States Station recalled the heavy losses from the spruce budworm in Minnesota during the 1910-26 outbreak and stated that the spruce-fir types are again rapidly nearing susceptible age and condition. The recent widespread outbreaks in the West as well as in Canada have resulted in tremendous reductions in the future pulpwood supply. Surveys in 1954 indicated increasing numbers of the insect throughout northeastern Minnesota. Already in northern Michigan some trees are dying from the attacks. A distinct threat to the paper industry is imminent.

The jack-pine budworm, although not as serious a pest as is the spruce budworm in the spruce-fir types, is one of the more important insects affecting jack pine in this region. D. M. Benjamin of the University of Wisconsin reported that damage surveys indicated some losses in pole and sapling stands and in reproduction. Cutting practices to remove the overmature and open-growing trees on which large populations of budworms develop were advised particularly when markets are brisk. Slack markets may prevent carrying out this measure on a large scale.

About 325,000 acres of merchantable tamarack type in Minnesota were defoliated in 1954 by the larch sawfly according to L. C. Beckwith of the Lake States Station. Although this insect has been in epidemic form since 1949 no tree mortality has resulted. Reduction in increment has occurred, however, and this may be the forerunner of stand decadence. Heavy defoliation occurred in northeastern Wisconsin but in the remainder of the state and in Michigan defoliation was light.

J. W. Butcher of the Minnesota State Entomology Department stated that the forest tent caterpillar epidemic is virtually at an end in the aspen types in Minnesota; a drastic decline in acreage of defoliation is predicted for 1955. N. B. Underwood of the Wisconsin Conservation Department reported that, although heavy defoliation had occurred in northwestern Wisconsin in 1954, the moth populations had declined very materially due to parasitization. As a consequence lighter defoliation is expected in 1955. R. C. Fox of the Michigan Conservation Department reported a similar condition in the Michigan areas of infestation.

The pine sawflies have been increasing in abundance in recent years, and Mr. Fox stressed the need for reporting developing infestations so that control operations can be carried out before tree mortality occurs.

R. D. Shenefelt of the University of Wisconsin stated that the pine tortoise scale was still a threat in many jack pine plantations and stands. Control operations to reduce the scale populations and prevent tree mortality may again be necessary in 1955; hence reporting of local infestations should be continued.

Fires on National Forests Drop 12 Percent During 1954

The number of forest fires on national forests during 1954 dropped 12 percent from 1953, according to the U. S. Department of Agriculture.

Forest Service field offices reported 10,462 forest fires during 1954 as compared to 11,950 during 1953. Man-caused fires remained about the same for the two years: 5,978 in 1954 and 5,960 in 1953, in spite of the fact that use of the national forests increased tremendously during the year.

The region showing noticeable increase in man-caused fires was the Southern, made up of 11 states extending from North Carolina to Texas. Forests in this area reported extremely dry conditions starting in January and continuing through the summer and until late fall. Man-caused fires there totaled 2,642 in 1954 as compared to 1,716 in 1953.

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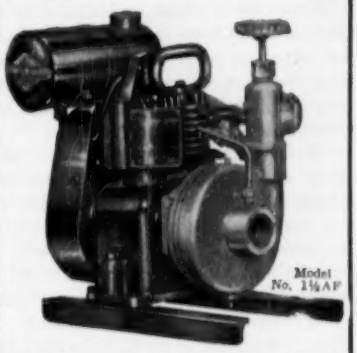

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Resources for the Future Reports on First Year of Regular Program

Needs for research and education in the social sciences to match technological advances in development, conservation, and use of natural resources are emphasized in the annual report of Resources for the Future, Inc.

"Every year," the report says, "private and public enterprises become larger and more complex. Technological advance tends to segregate vital knowledge in the hands of a few specialists in each branch of science. Such progress can be compatible with the democratic process, but not without effort. The basic facts that bear on the main issues must be distilled from a great body of technical material, analyzed objectively, and made available to the people."

The 36-page report covers the work of Resources for the Future for the year ending September 30, 1954. During the earlier part of that period the organization sponsored the Mid-Century Conference on Resources for the Future, held in Washington in December, 1953. The final report of the Conference was prepared during the fiscal year and published soon after its close, *The Nation Looks at its Resources.*

Following a grant of $3,410,000 from The Ford Foundation last June in support of a program of research and education for a period ending September 30, 1959, Resources for the Future began its longer range work.

A special group was organized under staff auspices to canvass problems of regional analysis in resource development and to prepare a study on that subject.

A grant of $200,100 was made to the National Planning Association for a two-year study of the economic and social possibilities of nonmilitary use of nuclear energy.

A grant of $67,500 was made to the University of Chicago for an analysis of certain aspects of federal ownership and development of natural resources, particularly methods for estimating benefits and costs, and pricing policies in the sale of services or products.

A grant of $40,000 was made to Harvard University for continuation during the 1954-55 academic year of a seminar for research and training in rural land-use adjustment.

These projects, the report points out, do not fully represent the scope of the organization's future work. "A considerably broader program is contemplated for subsequent years. It is very clear, however, that the total work program must always be small in comparison with the needs for research and education in the field of natural resources. As the resident staff is rounded out, it is likely that Resources for the Future itself will assume a much larger share of the total research program than it could undertake during 1954."

Resources for the Future, Inc., is a nonprofit, tax-exempt corporation for the purpose of improving the development, conservation, and use of natural resources through programs of research and education, principally in the social sciences. It was established in October, 1952, with the cooperation of The Ford Foundation.

Education

Louisiana Forestry Symposium Dates Changed

The Fourth Annual Forestry Symposium will be held on the campus of Louisiana State University, Baton Rouge on Wednesday and Thursday, April 6-7. This is a change from the originally scheduled dates of April 7-8.

P. Y. Burns Heads Louisiana School

Dr. Paul Y. Burns was recently appointed director of the Louisiana State University School of Forestry. He succeeded Ralph W. Hayes, who retired September 1 after 20 years but is remaining on the faculty.

Burns previously held the position of associate professor of forestry at the University of Missouri. He received both his masters and Ph.D. degrees from Yale University.

Short Course on Tree Improvement for Forest Managers

A three day short course on forest tree improvement will be sponsored by the Texas Forest Service May 31—June 2, at Lufkin, Texas. This course, under the direction of Dr. Bruce J. Zobel, is designed to explain and demonstrate to the practicing forester basic principles of inheritance that can be used as a silvicultural tool in managing forest lands.

Cooperating with Zobel in conducting the short course will be Philip C. Wakeley, silviculturist, Southern Forest Experiment Station; Dr. Thomas O. Perry, assistant professor of forestry, University of Florida; and Ray E. Goddard, assistant silviculturist, Texas Forest Service.

The short course will be of special interest to foresters who are engaged in managing forest land. Applications for the course are now being received. Early registration of interested individuals is urged. It will be limited to 60 individuals.

For further information on the short course, a letter of inquiry should be addressed to Texas Forest Service, College Station, Texas.

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Alabama's Forest Industry

A report on Alabama's forest industry has been issued as Forest Survey Release 74 by the U. S. Forest Service's Southern Forest Experiment Station.

The report summarizes data compiled during the new survey of Alabama's timber resources. It includes production statistics by county for lumber, pulpwood, cooperage, veneer, mine props, fuelwood, fence posts, hewn ties, poles, piling, and naval stores. Statewide trends in the output of major products are briefly discussed.

Alabama leads the Mid-South in lumber production, according to the report. Since 1944 hardwood has made up about three-tenths of the state's annual lumber production. That Alabama's present lumber cut has approached the peaks of the 1920's is due in part to the big boost in hardwood manufacture.

An important feature of Alabama's wood-using industry in recent years has been the great increase in pulpwood production. From less than 300,000 cords in 1938, production rose to 1,400,000 in 1951—an average increase of 86,000 cords a year.

A new development likely to modify the pattern of pulpwood procurement is the use of coarse sawmill waste for pulp chips. Several installations for producing chips from bark-free material are now operating in Alabama and more are in prospect.

Copies of the report may be secured from the Southern Forest Experiment Station, 2026 St. Charles Avenue, New Orleans 13, La.

J. W. Lanier Appointed Railroad Forestry Agent

James W. Lanier, a forester with the North Carolina Division of Forestry at Winston-Salem, joined the forestry department of the Atlantic Coast Line Railroad January 1. He was appointed forestry agent with headquarters at the company's home offices in Wilmington, N. C.

Lanier is a native of Lake City, Fla. He attended Gordon Military College, earned his B.S. Degree in Forestry at the University of Georgia and his M.S. at the University of Florida.

Prior to his connection with the Coast Line the forester held positions with the U. S. Forest Service in Oregon, and the Georgia Forestry Commission, in addition to his service with the North Carolina Division of Forestry.

Homelite Corporation Makes Scholarship Award at Penn State

The Homelite Corporation of Port Chester, New York, has recently granted a $500 scholarship award to an outstanding forestry student in the School of Forestry at The Pennsylvania State University. This award, known as the "Homelite Forestry Scholarship," is given to help spread the application of good forestry management through aiding in the training of a deserving student. Presentation of the award is to be made annually by donation from the Homelite Corporation.

Presentation of the award was made by W. B. Livingston, Pittsburgh, district manager for the Homelite Corporation, at a convocation of the Forestry School. Associate Dean R. B. Dickerson of the College of Agriculture assisted in the presentation.

The student, George Yelenosky of Cambria County, is a Marine veteran and has worked both in lumber camps

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Yes—IT'S TRUE that 4 Nelson quarts are more economical than the cheapest paints you can buy by the gallon. Quality in paint as in other things—not only pays for itself but saves—because—you use less and you save time, the most important factor cost-wise. Prove this for yourself—Send your order today or write for free bulletin and prices, Dept. JF-22.

THE NELSON COMPANY Iron Mountain, Mich.

W. R. LIVINGSTON of the Homelite Corporation in the center makes the Scholarship Award to honor student in forestry, George Yelenosky at The Pennsylvania State University. On the right, Associate Dean R. B. Dickerson of the College of Agriculture and on the left Dr. W. C. Bramble, acting director of the School of Forestry.

and in the U. S. Forest Service while a student. He is an honor student working his way through the University.

Forest Insurance to be Available in South

The South Carolina Insurance Company of Columbia, S. C., has announced that it is completing arrangements to write forest insurance on merchantable timber, unmerchantable timber, and plantations, in the 11 southern states from Virginia and Tennessee to Arkansas and Texas.

Merchantable timber is defined as living softwood trees at least 6 inches d.b.h. and hardwood trees at least 8 inches d.b.h. Unmerchantable timber is defined as living trees at least 1 foot in height not classified as merchantable.

Written application for insurance is required showing the applicant's valuation and the amount of insurance desired. In addition, information is called for showing acreage, volume, and market value of pine and hardwood, average d.b.h. of trees to be insured, fire history, extent of logging operations, type of fire protection, and nature of terrain and under-brush. For plantations the species, age, percent stocking, spacing, and cost of planting are needed. A legal description and plat may also be required.

In the case of both merchantable and unmerchantable timber, the company is liable only for the difference between the value of the standing trees before the fire and their salvage value immediately after the fire. In the case of plantations of unmerchantable size, on the other hand, the company is not liable for more than a stated amount per acre in addition to the cost of planting. Plantations less than 2 years old have no insured value and in case of loss only planting costs can be recovered. Plantations 2 years old are valued at not more than $4 per acre; those 3 years old at not more than $8 per acre, and so forth increasing $4 per year up to plantations 19 years old which are valued at not more than $68 per acre. Insurance recoveries under the policy are subject to a deductible of 2 percent of the value of the insured trees located on the burned or lightning struck area or $150, whichever is the greater.

The premium is calculated by multiplying the amount of insurance by a base rate for the state as a whole and then making adjustments upward or downward to reflect conditions on the individual property. Base rates together with credits and surcharges are indicated as follows:

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New Attachments

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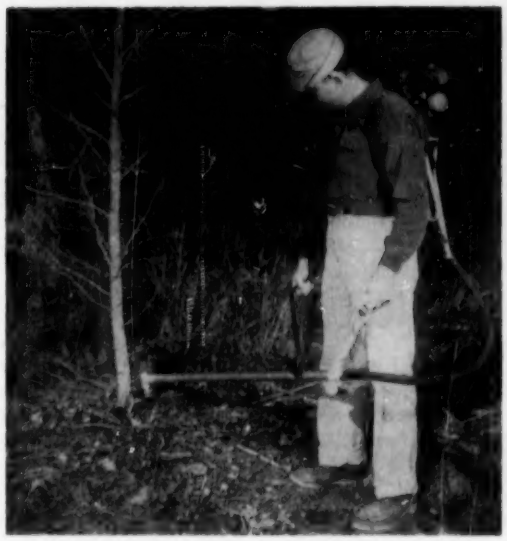
Due to many requests, the Little Beaver Tree Girdler has been *modified* to accomplish *other* vital jobs so necessary to good forestry practices. Many acres have reverted to weed species and brush due to past management. Heretofore these areas have presented a problem as to how they could be put back into production for a reasonable investment.

With the saw attachment for the Little Beaver this "thorn in the side" has been removed. For rapid and efficient work in removing small growth and underbrush nothing can beat the Little Beaver BRUSH SAW. Saplings up to 4 or 5 inches at the base can be cut in a matter of seconds.

Also, due to immeasurable flexibility, the Little Beaver Brush Saw can be used for pruning young stands of saplings and pole size trees. An *extra four foot aluminum section* is available which allows for pruning at greater heights with minimum effort—another step in attaining economy in intensified forest management.



The Little Beaver is now available with both the 1.6 H.P. and the 2.5 H.P. Clinton engines. The 2.5 H.P. engine provides for faster operation, deeper girdles, less maintenance and economy—and at no increased weight. To use the new *Post Hole Digger* attachment, it is necessary to have the extra power contained in the 2.5 H.P. engine.

—FIELD TESTED—

With the information received from our many customers and the knowledge of our own operation, we are confident that the Little Beaver is truly an efficient and economical power tool; designed especially for forestry. The development of this machine marks the passing of another mile stone in the progress of good forest management so vital to the welfare of our national economy.

Having been in operation since the summer of 1953, the Little Beaver has shown that it can stand the test. Many improvements have been effected, since a constant watch is kept to determine changes necessary for long, trouble free operation for the owner.

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State	Base rate per $100 of insurance
Alabama	$ 0.72
Arkansas	0.50
Florida	1.88
Georgia	0.56
Louisiana	1.04
Mississippi	2.24
North Carolina	0.76
South Carolina	0.56
Tennessee	1.20
Texas	1.68
Virginia	0.50
Annual minimum premium	50.00 (no exceptions)

Subtractions from the Base Rate

A. Forest protection
   1. County protection and owners equipment plus breaks 5%
   2. County protection and organized owner protection 10%
B. Tree size
   12" and up d.b.h. 5%
C. Fire resistance of species
   Longleaf pine 5%
D. Density of forest
   Heavy 2%
E. Underbrush
   Light 2%

Additions to the Base Rate

1. Lightning 2%
2. Naval stores 20%
3. Railroads 5%
4. Recreation 10%
5. Paved state roads 5%
6. No protection 50%
7. Tree size 0-6" d.b.h. 50%
8. Steep terrain 10%
9. Heavy underbrush 10%
10. Other recognizable hazards 5%-100%

Further information concerning this insurance may be obtained from Seibels, Bruce & Company, P. O. Box 1199, Columbia, S. C.

A.F.P.I. Gives Scholarships to Four 4-H Club Boys

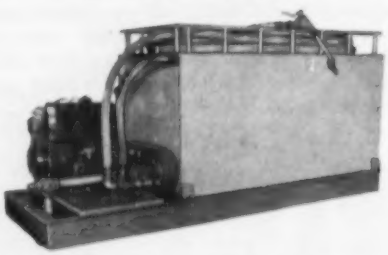
Four American farm boys, one of them a certified tree farmer, each won a $300 college scholarship in the national 4-H Club forestry contest sponsored by American Forest Products Industries.

The awards were presented formally in December at the National 4-H Club Congress in Chicago by James C. McClellan, A.F.P.I.'s chief forester. All but one of the winners are high school seniors.

The winners were Arnold B. Smith, 17, of Perkinston, Miss., a certified tree farmer; Duane J. Horton, 18, Sherburne, N. Y.; Larry Edward Syndergaard, 19, Hillsdale, Wis., who is now a freshman at Iowa State College; and Timothy L. Bagley, 17, Astoria, Ore.

The winners were chosen by the National Committee of State and Federal Extension Workers on the basis of actual accomplishments in 4-H club forestry projects.

PANAMA



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Government

Mississippi Produces Film on Tree Improvement

The Mississippi Forestry Commission announces the completion of "Developing Pedigreed Trees," an eighteen and one-half minute color-sound film dealing with Mississippi's program of forest tree improvement through research. Basic script was written by Hoy C. Grigsby, the Commission's research forester. Photography was done by Charles T. Shotts, press representative. The film is designed to publicize the importance and potentiality of forest tree research in terms that an average citizen can visualize. It points up characteristics desirable in forest trees for various uses and suggests that the quality improvement of our forest trees may be practiced by the timberland owner now without his having to wait for the results of the research. The film is available to educational and state institutions at no cost except transportation. Commercial organizations may order the film on a nominal rental basis from Mississippi Forestry Commission, P. O. Box 649, Jackson, Mississippi.

New Facts About Ohio Forests

Forests occupy 21 percent of the land area of Ohio and contain a timber volume of 14.4 billion board-feet according to reports released by the Central States Forest Experiment Station, U. S. Forest Service, at Columbus, Ohio. These reports, entitled "Forest Statistics for the Glaciated Region of Ohio" and "Forest Statistics for the Hill Country of Ohio" show forest areas and timber volumes for five subdivisions of the state.

The gently rolling farm country of western and northern Ohio is only 12 percent forested while the hill country of the south and east is 39 percent forest land. More than 90 percent of forest acreage is privately owned.

Forests of the glaciated region, though less extensive, have more timber volume per acre and better average log quality than the hill country forests, according to the reports.

Facts for these reports came from the recently completed initial Forest Survey of Ohio.

The total forest area shown in these reports exceeds by 47 percent the forest area determined by a survey made in 1939-43, and timber volume estimates have increased in proportion. The apparent area increase is because of some planting and natural reseeding, inclusion of some open woodlands not formerly classed as forest, and the greater intensity of the more recent survey.

Copies of the reports may be obtained from the Central States Forest Experiment Station, the Ohio Division of Forestry, and the Ohio Agricultural Experiment Station. A third report is being prepared showing the forest situation in the state as a whole and including figures on timber growth and cut.

FORGET SOMETHING?

If you have kept telling yourself, "I really ought to try that new paint and gun combination for marking trees which the Nelson Company has been advertising."—Don't put if off any longer—

See Page 311

and order at least one Nelspot gun and enough paint to prove for yourself that "4 quarts *do* cost less than 1 gallon, when you mark trees the Nelson way."

(*Adv.*)

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ATLAS "D" DEBARKING COMPOUND

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One gallon of Atlas "D" treats up to 200 trees . . . quickly brushed on sap-peeled girdle around each tree. Solution is colored green for easy identification of treated girdles. Animal repellent content makes deer, cattle and sheep shun treated trees or vegetation on which Atlas "D" has been spilled.

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DELAND, FLORIDA

Virginia "Plant More Trees" Program Launched

A program to "Plant More Trees" in Virginia was formally launched at the annual meeting of Virginia Forests, Inc., on February 2, when Governor Stanley publicly announced the appointment of a committee to head up this program. Consisting of nearly one hundred business, industry, government, and individual leaders, the committee will serve for three years in an effort to greatly increase the amount of tree planting in the Old Dominion.

Elected to head up and coordinate this program was an executive committee of twelve. This committee decided that the program would be for the three planting seasons beginning in November of this year.

A goal of at least 75 million trees was decided upon for the three year period. This would more than equal the total number of trees planted during the entire 33-year period that the Virginia Forest Service has been growing and distributing tree seedlings.

During the spring and summer months, it is understood that county committees will be organized, promotional material will be prepared, and funds will be raised in anticipation of starting the drive this fall.

The program calls for coordinating the efforts of many agencies, organizations, businesses, and industries.

H. E. Dobbins, New York District Forester, Retires

Harry E. Dobbins, district forester with the New York State Conservation Department, retired from active service on March 1. His appointment as district forester was effective March 1, 1930, at which time the state was starting its enlarged reforestation program. The district assigned to Dobbins consisted of the seven western counties of the state, known as District No. 5.

Under the enlarged reforestation program, approximately 42,000 acres of submarginal land was purchased in Chautauqua and Cattaraugus Counties and approximately 20 million trees have been planted on the open land. About one-half of the acreage is in natural woods, mostly valuable hardwoods.

Since 1946, the program of assistance to private woodland owners has been an important activity of the Conservation Department. Under this program, the district forester has acted as secretary for the District 5 Forest Practice Board.

In 1931, the first trees were planted under the State Reforestation Program. Today pulpwood is being harvested from several red pine plantations in the form of thinnings.

Dobbins graduated from the University of Michigan in 1920, after serving in the Army during World War I. His first assignment was in Oregon with the Indian Service where he supervised timber sales. He was transferred to the U. S. Forest Service in northern California on the Plumas National Forest and finally to Washington, D. C. where he engaged in acquisition work. He resigned from federal service to accept the appointment with the New York State Conservation Department.

Woman Member of Original Staff Forest Products Lab Retires

Dr. Eloise Gerry, one of the first women in the United States to make a career of forest products research, has retired after more than 44 years of government service at the U. S. Forest Products Laboratory, Madison, Wis.

Dr. Gerry was the only woman member of the original staff of scientists that opened the Laboratory in June 1910. Since that time her work, and the many technical publications she has authored have gained her international recognition.

A native of Boston, Dr. Gerry received her bachelor's and master's degrees at Radcliffe and her doctorate from the University of Wisconsin.

What Dr. Gerry describes as her most interesting period of research started about 1915, when she pioneered microscopical investigations of the turpentine pines of the South.

Her job was to find out what could be done to maintain the industry as the virgin forests disappeared and to increase the oleo-resin yield from the small trees that made up the young stands.

At a time when women scientists were a rarity and their venturing into the southern forests was practically unheard of, she packed her microscope and headed for the piney woods of Mississippi and Louisiana. Later, she followed the reconstituted industry into Alabama, Florida, and Georgia.

She covered the woods on foot, on horseback, and in Model T Fords, collecting samples which she studied in makeshift laboratories. Soon she had positive evidence of the damage done by the crude and heavy wounding of the trees. "They were killing the goose that was ready and willing to lay the golden egg," Dr. Gerry says.

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HIGH PRESSURE—Use one or two hard-hitting streams or fire-blanketing fog-spray
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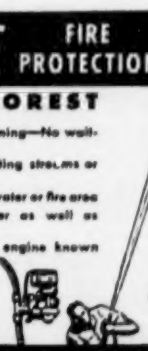
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Keith Cranston, *Forestry Consultant*
LELAND, MISSISSIPPI

Forestry Employment

S.A.F. members are privileged to insert one 60-word advertisement in this column without charge. Forest industries desiring to employ foresters may insert advertisements at the rate of $4 per column inch. Copy must be received by the end of this month for an advertisement to appear in the issue after next.

Obviously, the Society cannot assume responsibility beyond making it possible for prospective employee and employer to enter into negotiations.

Positions Wanted

B.S.F., 1951, 26, married. Presently member forestry staff, large lumber firm. Experience: supervision of contract logging, pulpwood procurement, commercial thinning, noncommercial T.S.I. program (pruning, hardwood removal); management and acquisition inventories; photogrammetric techniques; scaling; mapping; trespass; fire control. Desire change to greater responsibility and opportunity involving management and procurement with wood fiber or plywood industry in West, North, or East.
Box G, JOURNAL OF FORESTRY, Mills Building, Washington 6, D. C.

Forester, engineer, and draftsman. B.S.F. 1950, M.F. 1955, single, 27. Experience in Douglasfir and ponderosa pine regions; 2 years cruising, scaling, marking, and forestation for U.S.F.S.; 3 years logging engineering, topographic and construction surveying, and drafting for private industry. Desire responsible position with industry integrating engineering with forestry in Oregon, Washington, or California.
Box H, Journal of Forestry, Mills Building, Washington 6, D. C.

Forester, B.S.F. 1950, 32, married, veteran, desires permanent position with private industry in the Northwest. Five years of well-rounded experience in forest management and public relations as public service forester. Opportunity for advancement primary objective.
Box J, Jounal of Forestry, Mills Building, Washington 6, D. C.

Forester, 27, desires change toward greater responsibilities and opportunities. Four years experience in forest management and silviculture as research assistant. Willing to travel, northern locality preferred. B.S.F. 1951, married, one child, top recommendations.
Box K, Journal of Forestry, Mills Building, Washington 6, D. C.

B.S. Forest Management and Administration to be received June 1955. Age 24, veteran, draft free, married. Experience in photography, photogrammetry, radio, T.S.I. work, management of own land, and forestry writing. Have taken courses in journalism, audiovisual aids, business administration. Desire work in public relations, forestry writing, or research. Prefer location in southern states.
Box L, Journal of Forestry, Mills Building, Washington 6, D. C.

Graduate forester, 35. B.S.F., M.F., Forest Production 1948. Married, two children. Six years experience in cruising and buying timber and timber land. Nine months with Forest Service in fire control work and forest research. Hold Commercial Pilot certificate. Desire forestry position with private company where flying experience can be used to advantage. Prefer Lake States or East.
Box M, JOURNAL OF FORESTRY, Mills Building, Washington 6, D. C.

Dr. Gerry went to industrial leaders with her microscopical evidence and demonstrated her thesis of "less scar, better trees, more turpentine."

A photomicrograph of the inside of a pine tree and its resin-yielding tissues was her letter of introduction, and the temerity of a woman offering advice on how to turpentine better than the old timers did, gained her access to the inner offices, she said. Once explained, the improved methods soon won hearty cooperation.

The results of her work were later summarized in a Naval Stores Handbook, published by the Department of Agriculture in 1935. The publication became the "bible" of the naval stores industry and has served as a stepping-stone to present-day advances.

When this work was completed, Dr. Gerry again returned to fundamental studies of wood structure, such as the physiology of parenchyma cells, wound reactions, and the transformation of sapwood into heartwood. This work has served and will serve as the basis for future research.

In recent years, she has become an internationally known specialist on foreign woods, and she has accumulated and published data on many of the species of trees from all over the world that are now available to supplement native woods in short supply.

C. C. Buck and R. K. Arnold Promoted

Transfer of Charles C. Buck to Washington, D. C. and appointment of R. Keith Arnold to succeed him as chief of Forest Fire Research at the California Forest and Range Experiment Station of the U. S. Forest Service, has been announced.

A veteran of 25 years' experience in the Forest Service, Buck will become assistant to the chief of the Fire Research Division in the Washington office. He started his career of research in fire behavior and control at the California Station in 1933, after three years service as a forest ranger, and in 1939 was placed in charge of the Station's forest fire research program. Buck is an associate editor of the JOURNAL OF FORESTRY.

Arnold, formerly assistant professor of forestry at the University of California, is a specialist in problems of forest fire control. He holds degrees from the University of California, Yale, and the University of Michigan, where he earned his Ph.D. in 1951. His graduate studies were on the economic aspects of forest fire control. Arnold collaborated with the Station during the past year as general manager of Operation Firestop, an operational research project of 12 cooperating agencies in California.

Kenneth Wolfe Retires, Succeeded by W. E. Bates

Pacific Northwest Regional Forester J. Herbert Stone has announced the January 31 retirement of Kenneth Wolfe. He was replaced as staff officer in the Claims Section, Division of Recreation and Lands, by William E. Bates.

Mr. Wolfe has more than 40 years of public service to his credit. He is a forestry graduate of the University of Montana and began his career with the Forest Service in 1912 as a compassman, receiving a district ranger's appointment in 1917. He has been with the Forest Service since that time except for duty in World War I during which he was a member of the forestry engineers.

Bates has been with the Division of Recreation and Lands since September, 1954, having previously served in the Division of Timber Management.

R. K. Winters and M. E. Becker Return from Foreign Assignments

Robert K. Winters and Maxwell E. Becker have returned to the Forest Service following two-year technical assistance assignments with the F.O.A. in East Pakistan.

Winters was primarily concerned with plans and program for a new Forest Research Laboratory to be located at Chittagong, but also served as a general forestry adviser to the F.O.A. Mission for both East and West Pakistan. Becker served as adviser to the East Pakistan Timber Extraction Project, designed to increase the output of timber.

Winters is being assigned to the Washington Office Division of Forest Economics, where he will coordinate and assist in carrying out studies in the marketing of forest products in all forest regions. Becker is joining the Division of Forest Economics in the Lake States Experiment Station.

No. 6 of a series featuring state forestry practices, projects and products . .

Colorado —Top of the Nation!

Colorado has an average altitude of 6880 ft.,—75% of the nation's area over 10,000 ft. In this one state are located 52 of the 67 North American peaks with altitudes of more than 14,000 ft.

Between the 5,000 and 10,000 ft. elevations are almost 20 million acres of timberlands,—mostly softwoods such as pine, spruce and fir.

The state's principal industries, in order of their importance, are agriculture, manufacturing and tourists. Thus, while Colorado lumbering in itself is of minor national importance, Colorado's timberlands are none-the-less vital to the economy of the state.

Many of the principal rivers of the area, the Colorado, the Rio Grande, Arkansas, North and South Platte, have their headwaters in the Colorado highlands. These rivers depend on the Colorado watersheds for their water that supplies the irrigation and domestic needs,—not only of Colorado but of neighboring states. Thus, the first consideration of forest management is water production.

Of almost equal economic importance is the control of erosion,—always a threat in unlevel terrain, and the preservation of recreational and aesthetic features that promote the tourist industry.

These complex considerations are worked out jointly by federal services, controlling more than 14½ million acres, and by the State Forestry office, responsible for 7½ million acres, including some of the critical non-forested water shed area.

These various agencies guide a sound integrated conservation program in which recreational users preserve the state's beauties as they enjoy them, industry considers beauty and erosion control in its cutting program, conservative grazing strengthens erosion control as it adds to the wealth of the state.

The multiple use of forestlands demands multiple responsibility for sound conservation methods. In Colorado, conservation is everybody's business!

—COLORADO STATE FORESTRY OFFICE, BOARD OF LAND COMMISSIONERS—*contribution to this series does not necessarily constitute endorsement of* SOUTHERN GLO *products.*

Whether he's marking in pulpwood stands, saw timber,—for cutting poles, piling, or other purposes,—the forester finds he can mark with paint almost double the number of trees he would mark with an axe. Speed and ease are two of the advantages discussed in a study "MARKING TREES with PAINT", prepared by the manufacturers of SOUTHERN GLO Tree Marking Paints. Write for your FREE copy of this informative bulletin today.

SOUTHERN COATINGS AND CHEMICAL COMPANY, Dept. 2, Sumter, South Carolina

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W. H. Larrimer Retires

Dr. Walter H. Larrimer retired from the Forest Service December 31. With the exception of a year of service in World War I he has been with the Department of Agriculture since 1913. He transferred to the Forest Service in 1935 from the Bureau of Entomology and Plant Quarantine. He received his bachelor's degree in forestry from Ohio State University in 1913 and his Ph.D. from the same institution in 1925.

E. H. Juntunen Heads State and Private Division at Missoula

The Forest Service has announced the transfer and promotion of Emil H. Juntunen to head the Division of State and Private Forestry for the Northern Region of the Service at Missoula, Montana. He has served as assistant in the Division of State and Private Forestry in the California Region since 1951. Juntunen took over his new duties effective February 1.

T. A. McClay Appointed Economist Northwest Experiment Station

The appointment of Thomas A. McClay to a new position of forest economist at the Pacific Northwest Forest and Range Experiment Station, Portland, Ore., has been announced by Director Robert W. Cowlin.

McClay has recently been with the Southeastern Forest and Range Experiment Station where he was engaged in research on the economic and financial aspects of forest management in the southern pine region. He participated in developing and applying the U. S. Forest Service Interim Log Grades for southern pine and has written numerous publications dealing with the growing and harvesting of timber crops.

In his new position McClay is assigned to the Division of Forest Economics Research and will conduct independent research as well as furnish consultation and advice to other research divisions of the experiment station, national forest personnel, and other groups interested in the economic aspects of forestry.

Prior to his assignment in 1947 to the Southeastern Station, McClay worked for several years on national forests in California and at the California Forest and Range Experiment Station.

He received a forestry degree from the University of California in 1941 and completed work on a master's degree at Duke University in 1949.

Equipment & Products

Lightweight Leaders

Increased use of lightweight metal ladders for genetics work and seed collection is reported by Alfred Wigglesworth of Modern Magnesium Products, Inc., Palmer, Mass.

The company manufactures "Mighty-Lite" magnesium alloy ladders in 6-, 7, and 8-foot sections. The sections fit into each other in such fashion that almost any desired length may be had. Brackets hold the ladder away from the tree trunk and thus afford the climber a toe hold.

Mighty-Lite ladders, the manufacturers claim, are one-third lighter than aluminum; they weigh only 1¼ pounds per lineal foot.

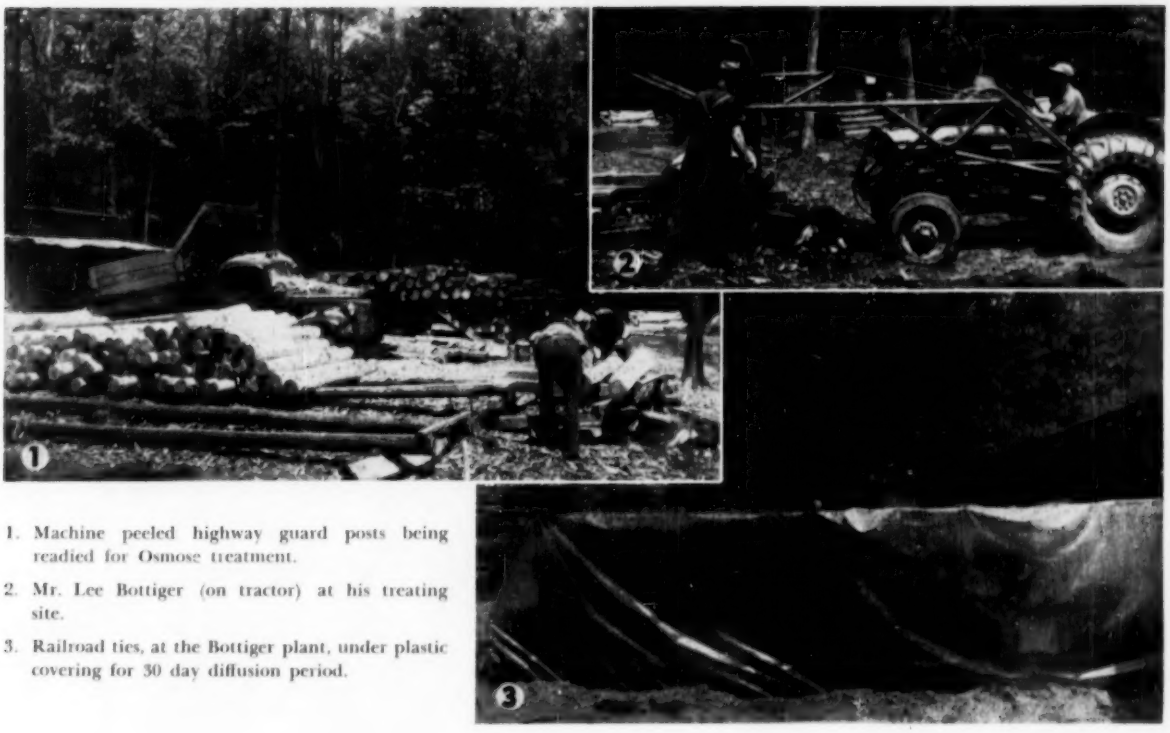
Mosquitos Bite You?

According to a news release of the Kentrol Corp., 10 East Coulter St., Philadelphia 44, a new tablet has been developed that, taken orally, provides protection from mosquitoes. Said to be odorless, tasteless, and harmless even to small children the repellant is called Bite-Ban. It is to be made available through drug stores, and the distributor reports that it will undergo tests by the Armed Forces.

Chemical Solutions Bulletin Available

A technical bulletin on bleeding of pentachlorophenol-petroleum solutions from pressure-treated wood and how to reduce or prevent this nuisance has been prepared by the Chapman Chemical Company. Tests reported in this bulletin, indicate trapped air in the interior of the wood is primarily responsible for such bleeding. Gradual escape of the air after treatment forces preservative to the surface of the wood. A final steam flash is recommended as the most effective method of reducing bleeding after treatment by a standard empty-cell schedule. Suggested schedules for using this method on various species, sizes and forms of seasoned wood are given.

For copies of the bulletin, write Chapman Chemical Company, Box 138, Memphis 1, Tennessee, requesting Technical Newsletter No. 14.



1. Machine peeled highway guard posts being readied for Osmose treatment.
2. Mr. Lee Bottiger (on tractor) at his treating site.
3. Railroad ties, at the Bottiger plant, under plastic covering for 30 day diffusion period.

GOOD PROFITS IN WOOD TREATING

says operator

Saw mill operators have been intrigued for a long time with rumors of good profits in wood treating. For that reason we decided to do a reporting job for you on the experience of Lee J. Bottiger of Mt. Pleasant Mills, Pennsylvania.

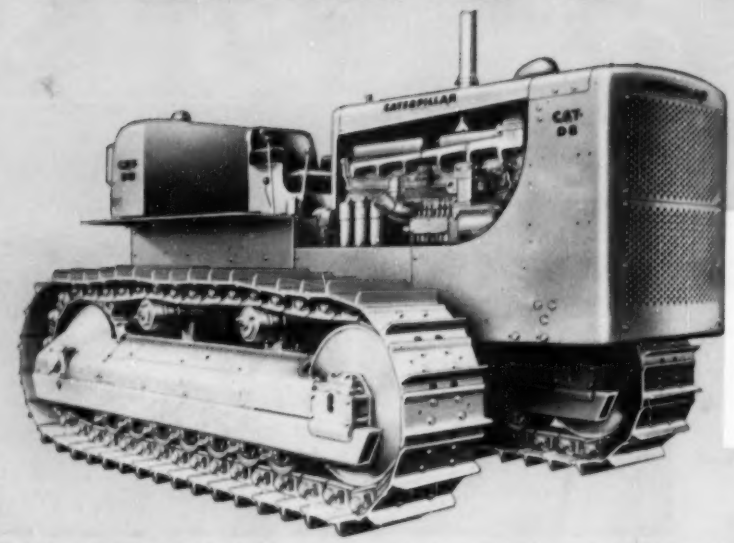
Mr. Bottiger owns and has been operating two saw mills for years. Two years ago, a friend of his, operating a wood treating plant producing only highway guard fence posts, was so busy that he asked Bottiger for help in getting out his orders. Poor health, subsequently, forced this friend to relinquish his Osmose Wood Treating franchise and Lee Bottiger was given the franchise. Since then the operation has expanded from merely guard posts to railroad ties and timbers, farm fence posts, bridge timbers and decking etc.

Today, Mr. Bottiger says, "I heard of the Osmose treatment through my contacts with large Anthracite mines who have successfully been using Osmosalts treated props and ties for years. When the Pennsylvania Department of Highways accepted Osmose on their specifications, I decided to take an active interest in Osmose treating. For the first year I treated nothing but highway guard fence posts for a friend of mine who was the licensed Osmose treater in my area. After he was forced to give up treating due to poor health, I took over his franchise and since then I have operated on my own. During the past two years, I have treated more than 35,000 guard fence posts and thousands of board feet of heavy timbers and switch ties. I will say that excellent profits can be attained with my Osmose plant and I look forward to a prosperous Osmose future."

In case you would like details on the possibility of getting into this profitable business yourself, we would suggest that you write Joseph M. Bray, Vice-President, Osmose Wood Preserving Co. of America, Inc., 980 Ellicott St., Buffalo, N. Y.

(Advertisement)

CATERPILLAR ANNOUNCES THE NEW D8



SERIES D and SERIES E

Choice of torque converter (Series D) or direct drive (Series E)

Here's a major advance in tractor design—the new CAT* D8 Series D and Series E. While it still bears the name of the unit that earned world-wide recognition as "boss of the crawlers," it is basically a *new* machine.

From its new 7-track roller track frame to its new engine, 155 HP at the drawbar and 191 HP at 1200 r.p.m., it is built to set new standards of money-making production. Along with its advance-design features, it retains such outstanding Caterpillar exclusives as the oil clutch and other job-proved developments. As a result, you can figure on it for *more* work at *lower* cost with *less* down time on *any* job.

Production-wise and profit-wise, you have a new yardstick of performance in the D8 Series D and Series E. For complete details, see your nearby Caterpillar Dealer.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

NEW ***ENGINE***, with new fuel injection system. Flanged center main bearing to take crankshaft thrust. Timing gear integral with crankshaft. Many other advantages.

NEW ***"LIVE-SHAFT" DRIVE***, independent of flywheel clutch, provides constant power for rear-mounted cable controls, etc., whether or not tractor is in gear.

NEW ***ONE-PIECE WELDED STEERING CLUTCH CASE***—main frame assembly for a stronger "backbone." Transmission removable without disturbing clutch.

NEW ***"EASY WORKING" CONTROLS*** handy to comfortable, one-man seat. New streamlined hood for visibility.

NEW ***OPTIONAL DRIVE***, torque converter or direct drive. Torque multiplication of 5 to 1 gives smooth, efficient operation in each speed range.

NEW ***7-ROLLER TRACK FRAME FOR GREATER STABILITY***, flotation and better ride.

NEW ***"WATER-QUENCHED" TRACK SHOES*** for longer life than ever before.

NEW ***"IN SEAT" STARTING*** for greater convenience, with new, more powerful starting engine for faster starts in any weather.

NEW ***HYDRAULIC BOOSTER STEERING***, independent of flywheel clutch, for maximum steering ease.

NEW ***118-GALLON FUEL TANK***, large enough for normal 12-hour operation.

NEW ***ATTACHMENTS*** include new cable controls. Also, new, larger bulldozer blades. All equipment used on the D8 can be used on the new D8 Series D and Series E.

NEW operating weight—D8 Series E (direct drive), 40,430 lb.; Series D (torque converter), 41,265 lb.

AND MANY OTHER NEW FEATURES!

MAIL TODAY!

CATERPILLAR TRACTOR CO., Peoria, Illinois, U. S. A.

I'd like more information on the new D8 Series D and Series E

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Company _____

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The NEW D8 Tractor —another example of CATERPILLAR LEADERSHIP in action